UiT
THE ARCTIC UNIVERSITY OF NORWAY

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The Association of Smoking Status with Education, Income, Marital Status, BMI and Physical Activity in Norway. An Analysis from 1974 to 2003.

The Smoking and Cancer Project

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HEL-3950 Master's thesis in Public Health
December 2016

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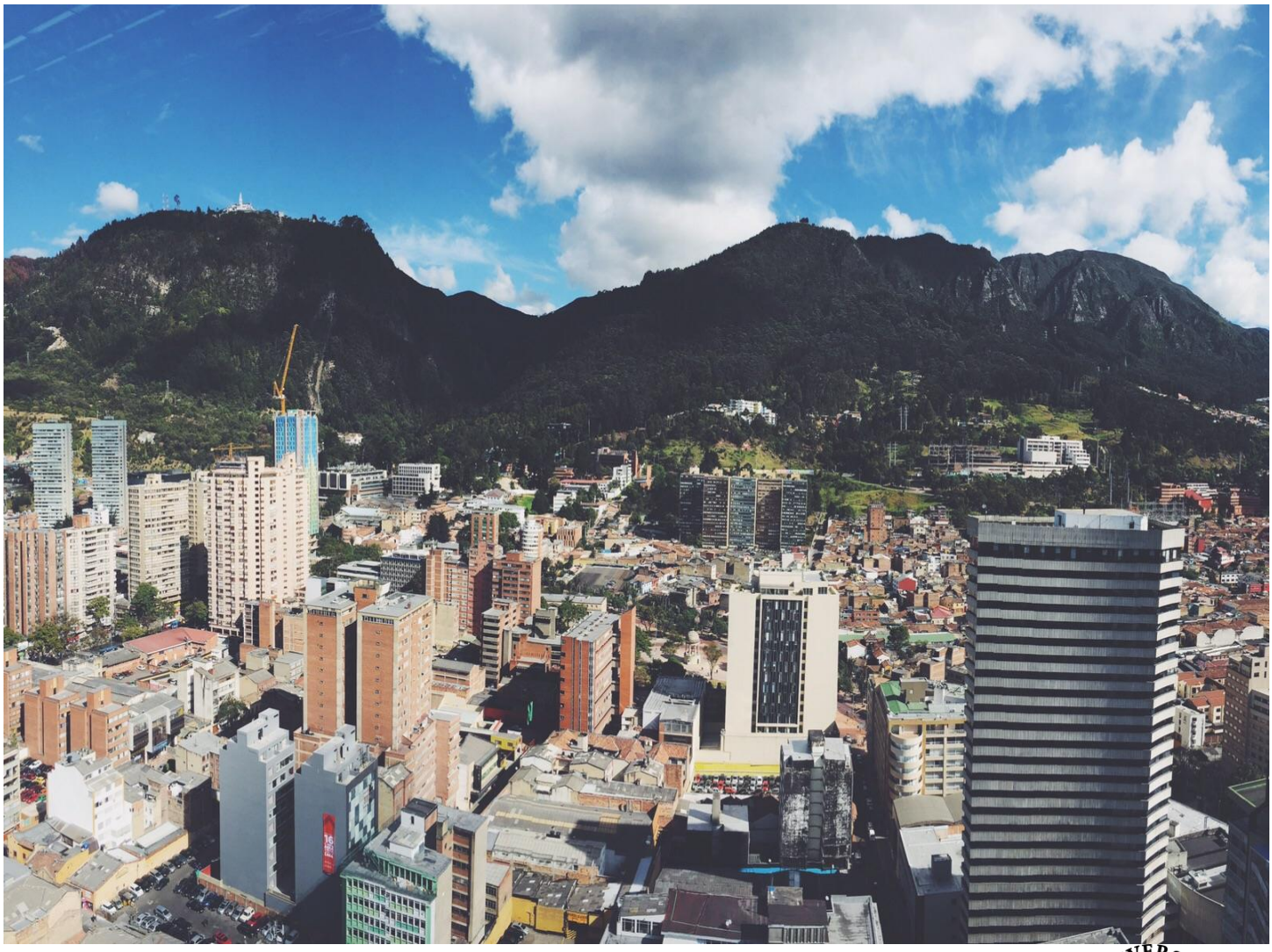

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Acknowledgments

Quiero dedicar esta tesis a mi abuelita, fuente infinita de amor, fuerza y sabiduría. Sientadita, sin ti, nada hubiera sido possible.

Mamita, no existe un día en que no me sienta agradecida de ser tu hija, eres mi ejemplo a seguir, mi guerrera, mi heroína, mi gemela. Gracias por ser la major mamá y tatica del mundo !

Gracias a todos los miembros de mi familia en Colombia por creer en mi y apoyarme siempre, a mi hermano Antonio, a Germancito, a mi Papi, a mis hermanas Maria y Aleja, a mi tio Pachito, a mi tia Laura, a Marito, y a mis primis.

I would like to thank my supervisors, Professor Inger T. Gram and Professor Idlir Licaj, for being a superb source of support and inspiration, for your patience and the magnificent feedback during the whole process. It is an honor to have worked under your supervision, I will be forever grateful for the enormous amount of knowledge you have shared with me.

I also want to thank Tor Gisle and Professor Bjarne Jacobsen, as representatives of the Department of Community Medicine, your support, guidance and encouragement, helped me to grow and develop in every step of this academic adventure.

Sveinbjørn my love, my soulmate, thank you for joining me in this incredible journey, and for bringing Antonio along, you guys are the engine of my existence.

My thanks goes also to my Norwegian family for their unconditional support and love, Aud, Jon, Sigrun, Gro-mette, Tora, Asbjørn 1.0 and 2.0, Cato, Gudmundur, Einir, Hrafnhildur and Hlinur, you guys rock !!!

December 2016, Angie Carola Alarcon Rios

Abstract

Background: Cigarette smoking is still responsible for a significant loss of life in many countries; Despite decades of research about smoking health consequences and informational campaigns, cigarette use continues to be a part of Norwegian society and culture; Differences in smoking status prevalence for men and women, continue to be associated to inequalities in Socio-economic status (SES) and demographic characteristics such as marital status and life style.

Objectives: The purpose of this thesis was to examine by gender the smoking status prevalence, its associations and changes in distribution according to selected Socio- economic and lifestyle characteristics, in a Norwegian population of 634,819 men and women, using a four group time period based on calendar years from 1974 to 2003.

Methods: This cross sectional study analyzed data from 634,819 Norwegian men and women that participated in the 40 years study, the three counties study and the Cohort of Norway Study, from 1974 to 2003. A univariate descriptive analysis was done to examine the male and female studied population by smoking status with education, income, BMI, marital status and physical activity as variables of interest. The effect of each variable was examined controlling on the other variables and age at inclusion. A multivariable logistic regression analysis with 95% (CIs) was performed to determine current and former smoker's odds, by levels of education, income, BMI, physical activity and marital status. All models were stratified by gender, smoking status and date of inclusion in four calendar periods [(1974-1980)(1981-1987)(1988-1995)(1996-2003)].

Results: The Male population experienced a decrease in the **prevalence** of current smokers from 53.9% in 1974 to 33.4% in 2003.

The univariate descriptive analysis showed the following changes in smoking status proportions in relation to SES and lifestyle characteristics from 1974 to 2003: Males with **high education level** increased from 6.7% to 14.1% among current smokers and from 17.5% to 34.7% among never smokers. Males with **high income level** increased from 48.5% to 50.3% among current smokers and decreased from 56.3% to 52.1% among never smokers. **Divorced/widowed** males increased from 3% to 15.7% for current smokers and from 1.2% to 6.9% among never smokers. Males with **BMI +30kg/m^2** doubled from 5.2% to 11.2% for current smokers and from 5.7% to 12.6% among never smokers. Males practicing **heavy**

physical activity increased from 1.2% to 24.2% for current smokers and from 4.2% to 34.3% among never smokers.

The multivariate descriptive analysis showed that for males that were included in the first period **(1974- 1980)**, they were **less likely to be current smokers** if they were in the **upper category** of **education** (OR = 0.24, 95% CI 0.21- 0.26), **income** (OR = 0.72, 95% CI 0.61- 0.85), **BMI** (OR = 0.70, 95% CI 0.61- 0.80), **physical activity** (OR = 0.24, 95% CI 0.20- 0.29) and, were **Single** (OR = 0.65, 95% CI 0.60- 0.71). In contrast, males were **more likely to be smokers** when were **divorced/widowed** (OR = 2.36, 95% CI 1.85- 3.02).
In the latter period of inclusion **(1996- 2003)**, males were **less likely to be current smokers** if they were in the **upper category** of **education** (OR = 0.18, 95% CI 0.17- 0.19), **BMI** (OR = 0.61, 95% CI 0.58- 0.64) and **physical activity** (OR = 0.53, 95% CI 0.50- 0.55). In contrast, males were **more likely to be smokers** when were **divorced/widowed** (OR = 2.04, 95% CI 1.94- 2.15), **Single** (OR = 1.11, 95% CI 1.07- 1.15), and in the upper category of **income** (OR = 1.38, 95% CI 1.28- 1.48).

The Female population experienced a decrease in the **prevalence** of current smokers from 39.3% in 1974 to 35.1% in 2003.

The univariate descriptive analysis showed the following changes in smoking status proportions in relation to SES and lifestyle characteristics from 1974 to 2003: Females with **high education level** increased from 5.1% to 12.6% among current smokers and from 10.3% to 32.3% for never smokers. Females with **moderate income level** increased from 70.2% to 72.4% among current smokers and from 65.3% to 66.1% among never smokers. **Divorced/widowed** females increased from 7% to 23% for current smokers and from 3.3% to 15.1% among never smokers. Females with **BMI +30kg/m^2** increased from 7.6% to 10.1% for current smokers and from 12.3% to 14.8% for never smokers. Females practicing **heavy physical activity** increased from .2% to 19% for current smokers and from .2% to 23.1% for never smokers.

The multivariate descriptive analysis showed that females that were included in the first period **(1974- 1980)**, they were **less likely to be current smokers** if they were in the **upper category** of **education** (OR = 0.25, 95% CI 0.22- 0.28), **BMI** (OR = 0.50, 95% CI 0.45- 0.55), **physical activity** (OR = 0.70, 95% CI 0.40- 1.21) and were **Single** (OR = 0.79, 95% CI 0.72- 0.88). In contrast, females were **more likely to be smokers** when and **divorced/widowed** (OR

= 2.26, 95% CI 1.99- 2.56) and in the upper category of **income** (OR = 1.82, 95% CI 1.61- 2.06).

In the latter period of inclusion **(1996- 2003)**, females were **less likely to be current smokers** if they were in the **upper category** of **education** (OR = 0.14, 95% CI 0.17- 0.19), **BMI** (OR = 0.55, 95% CI 0.52- 0.57) and **physical activity** (OR = 0.66, 95% CI 0.63- 0.69) and were **Married/cohabiting** (OR = 0.66, 95% CI 0.63- 0.68). In contrast, females were **more likely to be smokers** when were **Divorced/widowed** (OR = 1.37, 95% CI 1.30- 1.44) and in the upper category of **income** (OR = 1.63, 95% CI 1.53- 1.73).

Conclusions: From the initial studied period (1974- 1980) to the final (1996- 2003), the prevalence of male and female current smokers decreased significantly.

From the initial studied period (1974- 1980) to the final (1996- 2003) there was an increase in the proportion of males and females current smokers in the following categories:

- Higher level of education.
- Divorced/ widowed category.
- Higher levels of Physical activity
- Higher income levels
- BMI levels (+30kg/m^2).

In both, first (1974- 1980) and last studied period (1996- 2003) smoking was associated with SES and marital status. Lower levels of education and being divorced/widowed increased the likelihood of smoking for males and females in this study. In the same periods, lifestyle choices were also associated with smoking. Males and females in the upper levels of BMI and physical activity were less likely to smoke.

As for income levels and single marital status, these predictors showed contrasting associations with male and female current smokers in the first and last studied period.

Keywords: Smoking status, prevalence, Norway, socioeconomic status, SES, income, education, body mass index, BMI, physical activity, marital status, CONOR, 40 years cohort, three counties study.

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Abbreviations

SES	Socio- economic status
FCTC	Framework Convention on tobacco control
COPD	Chronic obstructive pulmonary disease
FCTC	World Health Organization Framework Convention on Tobacco Control
IARC	International Agency for Research on Cancer
WHO	World Health Organization
US	United States
UK	United Kingdom
BMI	Body Mass Index
PA	Physical Activity
CONOR	Cohort of Norway
HUNT	The Nord- Trøndelag Health study
HUSK	Hordaland Health Study
HUBRO	The Oslo Health Study
OPPHED	Oppland and Hedmark Health Study
MoRo	The Romsås in Motion Study
TROFINN	Troms and Finnmark Health Study
SSB	Statistisk sentrabyrå (Statistics Norway)
REK	Regional Committee for Medical Research Ethics
SD	Standard error
OR	Odds Ratio
CI	Confidence Interval
GDP	Gross Domestic Product

1. Introduction

Cigarette smoking is responsible for a significant loss of life all over the world (1). Differences in smoking status for both men and women, continue to be associated to greater inequalities in Socio-economic status (SES) in developed countries (2; 4). Like SES, other demographic characteristics such as marital status and life style choices (Body mass Index and Physical activity) have also been linked to smoking status (5; 9).

Despite decades of research about smoking health consequences and several prevention campaigns, cigarette use continues to be a part of Norwegian society and culture (10;14). As smoking plays an important role in a multidimensional social burden, in which specialized care, use of state resources and the population loss itself, has an enormous impact at a collective and individual level (15; 18), attempts at reducing smoking prevalence should be made.

This thesis focus is to examine by gender the prevalence of current and former smokers, and its association with Socio-economic status, marital status and lifestyle choices in three Norwegian cohorts conducted from 1974 to 2003.

1.1 Historical background of Tobacco use

The history of tobacco starts in South America, were the plant (*Nicotiana spp.)* was used in ceremonial and spiritual celebrations by different Caribbean tribes. These communities believed that the exhaled smoke filled up with prayers could reach their gods good will (19). After Columbus arrival to the Americas in 1492, the dissemination of tobacco plant seeds from the American continent enabled it's cultivation across Europe by the 1500s.

In 1612 commercial cultivation of fire cured dark leaf tobacco started in Virginia, USA. By the early 1800s, tobacco had reached the European aristocratic circles where it was snuffed,

chewed, and smoked by stuffing carved tobacco in sugar cane tubes or rolled into maize leaves (20, 21).

After the North American civil war, Virginian non-drying (flue-curing) bright tobacco entered the marked. This bright tobacco variety was made to be smoked in handmade cigarettes. In 1894, the first mechanical cigarette machine was manufactured, creating bigger scale production opportunities for producers who introduced newer varieties of tobacco plants along with advertising campaigns (21).

In the Second World War, tobacco producers reached a huge number of loyal consumers by donating millions of cigarettes to be distributed as a part of soldier's rations. By the end of the 19th century tobacco consumption steadily increased across developed countries, transforming cigarette smoking into a historical phenomenon that started almost invisibly in the late 1800s, and reached a massive peak by mid-20th century (3, 20; 22).

After this massive peak, different health authorities following the steps of the US surgeon general (the pioneer researcher on tobacco's negative effects on health), studied and distributed information about smoking consequences, concluding that, cigarettes are the only legal drug that kills its users when used as intended by its producers (17, 18, 23). These health information initiatives aimed to the general public, have resulted in a global decrease in cigarette smoking prevalence, as well as, a reduction in the morbidity and mortality attributed to smoking (15;18, 24;26).

1.2 Smoking trends in Norway

In Norway during the decade of 1930, tobacco was consumed by less than 10% of the adult population and mainly among high socio-economic status groups (3). Tobacco was chewed or consumed as moist snuff, for those who smoked it, pipe use was preferred. (11,14). After the

Second World War cigarette smoking increased alarmingly each year in the Norwegian population (20;22).

For Norwegian males cigarette consumption peaked in the decade of 1950, smoking was perceived as a symbol of modernity and freedom, and 70% of them were daily smokers. (3, 11;15). Figure 1 shows that after this peak, male smoking prevalence steadily declined in the following decades to 52% in 1973, 40% in 1980, 38% in 1990, 31% in 2000 and finally 16% in 2013 (24;27).

Meanwhile, Norwegian females followed a different pattern. During the 1950's women mostly abstained from smoking because it was considered vulgar and a sign of promiscuity (3, 22, 29). In the following decades the habit settles in the female population and by 1973, 32% of the women smoked daily (Figure 1). As time passed these smoking patterns remained stable, with 34% of females being daily smokers by the end of the 1980's and early 1990's. In the beginning of the 2000's a new pattern developed were the female proportion of daily smokers declined from 31% to 16% in 2013 (11,14, 22).

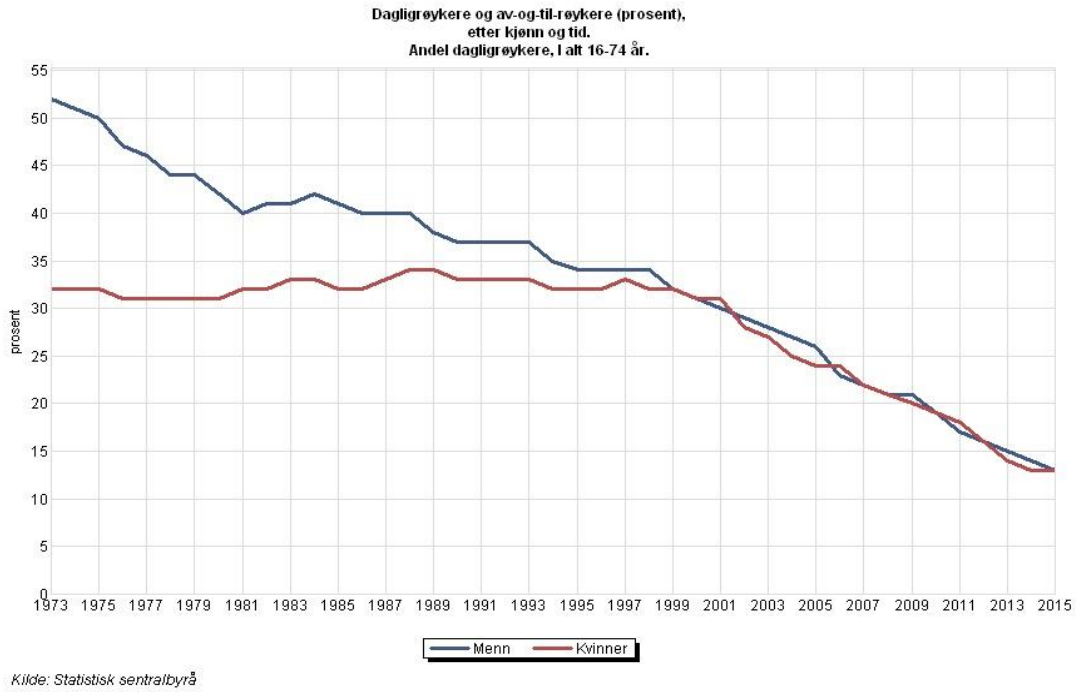

Figure 1. Male and female current smokers aged 16- 74 years in Norway. 1973- 2015. Statistics Norway (2016). Reprinted with permission.

1.3 The smoking epidemic model

Cigarette smoking trends in Norway, for both men and women, can be placed within the four stages of the tobacco epidemic model proposed by Lopez et al., 1994. Each stage is defined by three variables, the prevalence of current smokers, the amount of tobacco consumed in a time period and the mortality attributed to smoking in a population (figure 2).

In the initial stage, the male smoking prevalence is less than 20% and minimum 500 cigarettes per capita a year. Female cigarette smoking prevalence is below 10%. Deaths and diseases attributed to smoking at this point are almost imperceptible.

In the second stage, the male smoking prevalence reaches a peak up to 70%. The female smoking prevalence does not start to increase before 10 or 20 years later than the males, then, it is followed by a fast rise. The year per capita consumption is between 1000 to 3000 cigarettes. The smoking attributed mortality reaches 10%, mostly among males.

The third stage is suggested to be approximately 20 to 30 years, the smoking prevalence is lower in females (33%) than males (43%). The female smoking prevalence declines, mostly among high education groups. The per capita consumption its 3000- 4000 cigarettes a year. Deaths attributed to smoking reach 30%.

In the fourth and final stage of the epidemic, the smoking prevalence reaches 35% for males and 30% for women. For both genders, deaths attributed to smoking peak to 34%- 45% followed by a progressive decline to 10%- 20%. The smoking habit settles mainly among the lower socio-economic status groups, resulting in a parallel decrease in the smoking prevalence for both sexes across this stage (2, 21, 28; 31).

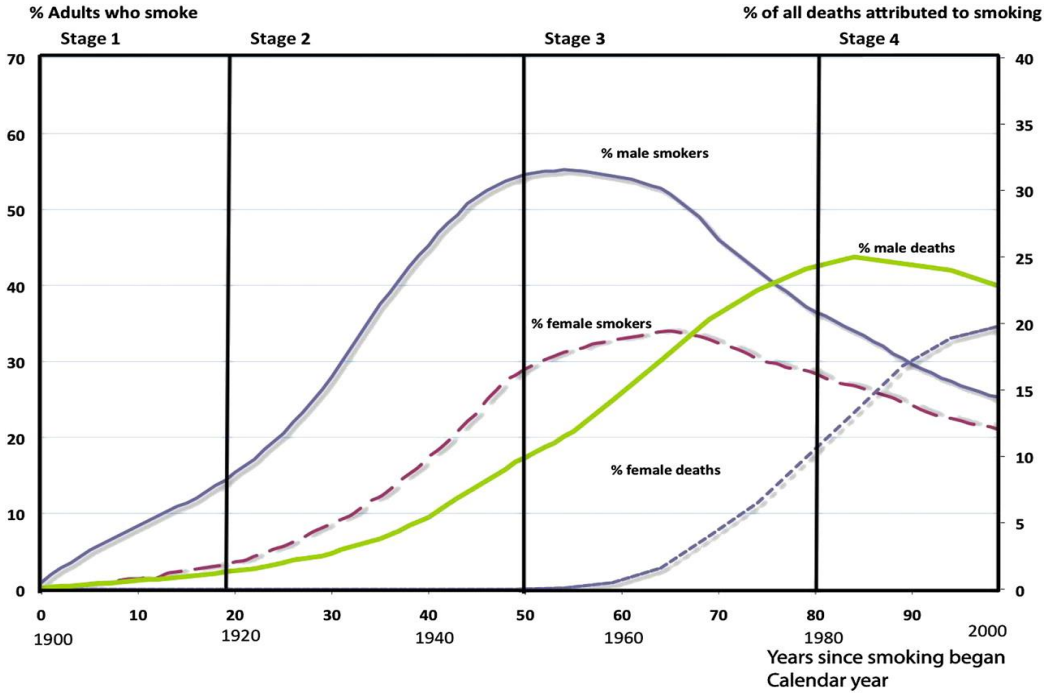

Figure 2. The four-stage model of the smoking epidemic. From Lopez et al. (1994). Reprinted with permission.

Different Scandinavian authors such as Kjønstad (1998), Lund & Lund (2014), Rönneberg et al., (1994) and Vedøy (2014), establish that tobacco consumption in Norway has followed the previously described patterns even though the time frame is slightly different. At present, Norway is experiencing a transition into the fourth smoking epidemic stage, with a decrease in the smoking prevalence and an increase in the proportions of deaths attributed to smoking for both sexes.

1.4 Public health developments and tobacco control policies in Norway

From 1930 to 1950, professor Kreyberg developed a lung cancer diagnosis protocol; He documented the lung cancer epidemic, and its incidence in rural and urban settings, as well as, identifying the subtypes of histopathological findings (15). In 1964, the first Surgeon General Report was presented in North America, exposing the causal relationship between smoking and lung cancer and many other illnesses.

In Norway, The Norwegian Medical Doctors Association reported findings from epidemiological studies associating lung cancer, bronchitis, emphysema, coronary infarction

and angina with cigarette smoking. In the following decades, organizations such as the Norwegian Cancer Society, The Public Interest Group Against Tobacco Injuries and The Publishing Company for Life and Health, developed initiatives to provide information to the general public about health hazards due to smoking (21).

In 1965, the Norwegian parliament appoints a special committee to discuss measures that can be taken in order to prevent people from starting to smoke, and to encourage smokers to quit smoking or diminish their habit. By 1967, the Committee's report "Effects of smoking behavior" suggested the introduction of advertising bans, health warnings, information measures and smoking cessation programs. Two years later, in 1969 the Report no. 62 is presented and its purpose is to take action against smoking (12).

In 1972, the Norwegian Council on Tobacco and Health, exposed the side effects on health of second hand smoke, followed by the 1975 tobacco act, that banned all tobacco advertising and made labels with health warnings mandatory (20, 17). By 1988 “røykeloven” or Norwegian Smoking Act protecting against passive smoking was introduced. It was followed by a regulation ban for new tobacco and nicotine products in 1989 prohibiting the import, sale and production of these products (12).

In 1996 the ban on smoking in open restaurants (eg. Malls, cafes) and inside schools and kindergartens is introduced. The age limit for smoking is raised from 16 to 18 years. In the year 1999, The Strategic Plan for Tobacco Control in Norway for 1999 - 2003, is presented from the Norwegian Ministry of Health and the National Council on Tobacco and Health.

By 2002 a ban on misleading product designations such "Light" and "Mild" is established. In the following year, the Ministry of Health conduct a mass media campaign "every cigarette harms you", focusing on the working methods of the tobacco industry. The same year, Norway

ratifies the World Health Organization Framework Convention on Tobacco Control (FCTC) (12, 21).

In 2004 a ban on smoking in hospitality venues was stablished along with a mass media campaign by the Ministry of Health, determining that everyone has a right to a smoke free workplace. By 2006 the Ministry of Health establishes the National Strategy for Tobacco Control 2006-2010, and the National Strategy for chronic obstructive pulmonary diseases (COPD) 2006-2011. The ministry of Health was in charge of conducting a mass media campaign on chronic obstructive pulmonary diseases (12).

In 2012 the Ministry of Health wins a case against Phillips Morris in the Oslo District Court on the legality of the ban on displaying of tobacco products. In 2013, a new tobacco strategy for the period 2013-2016 is presented "A tobacco free- future", a ban on packages with less than 20 cigarettes as content is implemented. From the 1 July 2014 Schools, kindergartens, entrances to health institutions and public agencies are declared tobacco-free based on the right to have a smoke free environment. In recent years the Tort law against the Norwegian tobacco industry has been developed, looking to obtain significant economic compensations to those affected by their addiction to smoking in their youth (12, 30, 32).

After 50 years from the first the Surgeon General Report, there have been important developments in the understanding of tobacco's health consequences. All over the world, Health authorities, governments and general public have become aware and vigilant regarding tobacco consumption (12; 18, 21; 26).

1.5 Socio-economic status and Smoking

Hiscock et al., (2012) defined Socio- economic status (SES), as an individual's location in society's structure. This social hierarchy, it's defined by the interplay of economic and social factors like education and income. From the introduction of industrialization in western

societies, this hierarchy has been reported to have a profound impact on the individual's health status (33;37).

Bjerkaas (2015), Gram (2009a, 2015b), Parajuli (2013) and Thun et al. (2012) have found in their research that, the incidence of diseases and premature death is higher for those individuals with a lower SES. As a result, every step up in the socio- economic scale, in the form of educational or income achievement, result in a reduction in morbidity and mortality.

When examining the relationship of SES with tobacco, social inequalities have been strongly linked to smoking status differences within a population. The IARC (2004a, 2012b), and the WHO (2015) have found that, cigarette smoking plays a direct role in poverty cycles. Money used to buy tobacco takes an important portion of the household income, displacing other goods (such as access to education), and it is often associated with poor health and disability from non-communicable and communicable diseases, resulting in elevated medical costs and income reductions that, reduce the future chances of prosperity, and any possibility of stepping up in the SES scale.

1.6 Marital Status, Lifestyle and Smoking

In Scandinavia, being married, has been well stablished as a protective factor against smoking, and a factor of success in smoking cessation. While divorced and single are more prone to be smokers (4, 5, 8, 9).

Studies carried out by Patel et al. (2000) in the US, and Dare et al. (2015) in the UK, have shown that BMI and physical activity has an effect over smoking status. On the long term, current smokers have a higher risk of obesity as a result of the increase in the amount of cigarettes smoked per day and little physical activity performed (5;7, 41;45).

2. Research Objective

The purpose of this thesis was to examine by gender the prevalence of smoking status and, its associations and changes in distribution, according to selected Socio- economic and lifestyle characteristics in a Norwegian population of 634,819 men and women, using a four group time period based on calendar years from 1974 to 2003.

2.1 Research Questions

a. How does the prevalence for current, former and never smokers in this study population differ from the first period of 1974- 1980 to the last period of 1996- 2003?

b. Which changes have occurred for smoking status with respect to Socio- economic status, marital status and lifestyle characteristics between the first and last periods?

c. How were the associations between Smoking status and socio- economic status, marital status and Lifestyle factors, in the first period 1974- 1980 and the last one 1996- 2003?

2.2 Specific Objectives

- To e**xamine** and **describe** by gender the smoking status **prevalence** (current, former, never smokers), in four calendar periods [(1974-1980) (1981-1987) (1988-1995) (1996-2003)].
- To **examine** and **describe** by gender the changes in proportions of the three socio-economic variables**: education level, marital status and income level** and the two lifestyle variables: **level of physical activity (PA)** and **body mass index**, in four calendar periods [(1974-1980) (1981-1987) (1988-1995) (1996-2003)].

- To **study and describe** by gender **smoking status** according to three socio- economic variables**: education level, marital status and income level**, in four calendar periods [(1974-1980) (1981-1987) (1988-1995) (1996-2003)].
- To **study and describe** by gender **smoking status** according to two lifestyle variables: **level of physical activity (PA)** and **body mass index** (measured as kg/m^2) in four calendar periods [(1974-1980) (1981-1987) (1988-1995) (1996-2003)].
- To **examine** by gender the **association** of **smoking status** with three socio- economic variables: **education level, marital status** and **income level**, in four calendar periods [(1974-1980) (1981-1987) (1988-1995) (1996-2003)].
- To **examine** by gender the **association** of smoking status with two lifestyle variables**: level of physical activity** (PA) and **body mass index** (measured as kg/m^2) in four calendar periods [(1974-1980) (1981-1987) (1988-1995) (1996-2003)].

3. Materials and Methods

3.1 Study population

The pooled data comprised 634,819 Norwegian men and women born between 1899 and 1975 that, participated in one of three different Norwegian health screening surveys: The Norwegian Counties Study, The 40 Years Cohort and the Cohort of Norway. These surveys were performed between 1974 and 2003 by the National Health Screening service, now, the Norwegian Institute of Public Health (Table 1). The participants were invited by mail and selected according to county of residence and age. They were given a baseline questionnaire which had to be completed before a short health examination. The main information obtained from this baseline questionnaire was associated with lifestyle factors, smoking habits, physical activity and level of education. During the health examinations height and weight measurements were obtained by trained personnel. This information was used to create the

body mass index variable (Kg/m^2). The rates of participation amongst surveys was 56-88% (46;48).

3.1.1 The Norwegian Counties Study

The participants of this survey were part of a cardiovascular disease screening in three Norwegian counties Finnmark, Sogn, Fjordane and Oppland. Residents from the general population of these counties with 35- 49 years and a random sample of 10% with 20- 34 took part in the first survey round (1974- 1978), the participation rate was 88% (88, 47). For the second round in 1977- 1983, and third round in 1985- 1988 besides previous participants, new cohorts with similar questionnaires were added. The attendance rates were 88% and 84% respectively (39, 46, 47).

3.1.2 The 40 Years Cohort

The participants of these surveys were part of a cardiovascular disease screening in 19 Norwegian counties from 1985 to 1999. Men and women aged 40- 42 years were the invited to participate, and some counties on the first and four phase of this study invited individuals aged 65- 67 years as well. The 40 years cohort has the largest number of participants (around 420,000) and it is the biggest cohort in the present analysis (38, 39, 48).

3.1.3 Cohort of Norway- CONOR

The participants of CONOR (around 181,000) were part of 10 regional epidemiological surveys conducted from 1994 to 2003 merged into a National database. Standard questionnaires (previously validated questions), procedures and protocols were implemented. The average response rate for the 10 surveys was 56% (39, 46).

Table 1. Norwegian surveys included in the study.

Survey Name	Number Surveys	Year	Location	Number of Participants
The Norwegian Counties Study	9	1974- 1978 1977- 1983 1985- 1988	Oppland, Sogn and Fjordane, Finnmark	93, 946
40 Years Cohort	19	1985- 1999	All 19 Norwegian Counties	403, 691
CONOR	10			137, 182
Tromsø health study IV	1	1994- 1995	Tromsø	
The second Nord- Trøndelag Health study (HUNT 2)	1	1995- 1997	Nord- Trøndelag	
Hordaland Health Study (HUSK)	1	1997- 1999	Hordaland	
Oslo study II	1	2000	Oslo	
The Oslo Health Study (HUBRO)	1	2000- 2001	Oslo	
Oppland and Hedmark Health Study (OPPHED)	1	2000- 2001	Oppland and Hedmark	
Tromsø Health Study V	1	2001	Tromsø	
The Oslo Immigrant health Study (I- HUBRO)	1	2002	Oslo	
Troms and Finnmark Health Study (TROFINN)	1	2002	Troms and Finnmark	
The second Romsås in Motion Study (MoRo II)	1	2003	Romsås	

3.2 Exposure and Covariate Information

The selected variables used in this study are from a pooled data set utilized in two PhD thesis. (38, 39). The obtained variables were already categorized.

The exposure variable smoking status, was categorized in the following way: **Current** smokers, **Former** smokers and **Never** smokers.

All of the survey questions concerning smoking were similar, but not identical (46; 48). This information is described in detail in Appendix A.

3.2.1 Socio- Economic Status and Marital Status

We choose **marital status**, **education**, and **income level** as indicators of Socio- economic status (SES). The SES variables were categorized in the following way:

- **Marital Status**: Married/Cohabiting, Divorced/Widowed and Single.
- **Education:** Low Education Level (0 to 10 years of school), Moderate Education Level (11 to 13 years of school) and High Education Level (13+ years of school).
- **Income:** (Low Income, Moderate Income and High Income).

Details about SES variables are described in Appendix A (38, 39).

3.2.2 Lifestyle

We choose physical activity and body mass index as indicators of lifestyle variables. The lifestyle variables were categorized in the following way:

- **Physical Activity:** Sedentary (reading, watching tv), moderate (walking, cycling and similar activities $\geq$ 4 hours a week,) and heavy (light sports or heavy gardening $\geq$ 4 hours a day).
- **Body Mass Index:**. 0 – 25 kg/m^2. 2. 25.1- 30 kg/m^2. 3. +30.1 kg/m^2.

Details about Lifestyle variables are described in Appendix A (38, 39).

3.3 Exclusion Criteria

The **analytical study population** comprised **577,326** Norwegians after exclusions were made (Figure 3). We used similar exclusion criteria as those in previous publications (38; 40). Our exclusions were defined in the following manner: Participants who had vital Status missing (n = 190). Participants who had a cancer diagnosis -except non- melanoma- before the start of the study follow up (n = 11,228). Death before the start of the study follow up (n = 570). Missing smoking information (n = 6,456). Emigration before the start of the study follow up (n = 242). Immigration after the start of the study follow up (n = 6383). Missing information on education (n = 19,470). Missing information on BMI (n = 9,454). Missing information on physical activity (n = 13,920). Missing information on marital status (n = 3,041).

3.4 Statistical Analysis

A **univariate descriptive** analysis was performed to:

- Describe the changes in **smoking status prevalence** (current, former and never smokers) for males and females in our study population.

- Describe the changes in proportions of **Education, Income, marital status, BMI and physical activity** for males and females in our study population.

- Describe the male and female studied population by smoking status (**Current and Former**) with **education, income, BMI, marital status and physical activity** as variables of interest. All variables were adjusted for age at enrolment as age has an important effect on the outcome.

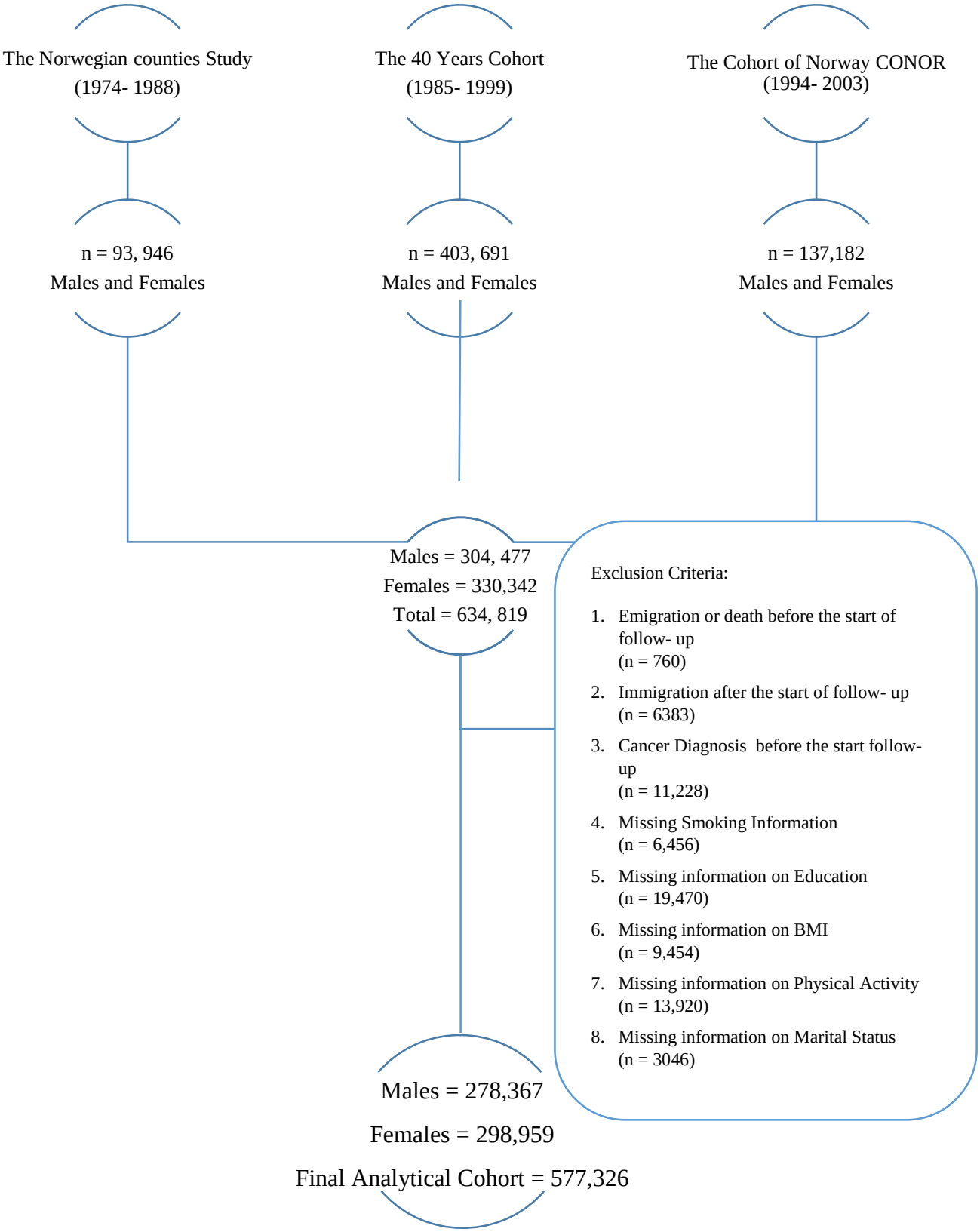

Figure 3. Flow chart of survey participants included the study

A **multivariable logistic regression** analysis with 95% confidence intervals was conducted to:

- Current and former Smokers were compared with Never smokers according to the selected Socio- economic and Lifestyle characteristics (we used as reference participants in the low education, low income, BMI of <25Kg/m^2, sedentary and married/cohabiting categories) to Examine the **association** of **education, income, BMI, Marital status and physical activity** with smoking status.

All results were considered significant if the p value was (< .05). Only subjects with complete information on all the variables of interest were included in the analyses to assure equal sample size and comparability between different models. All models were stratified by gender, and date of inclusion in four groups based on calendar years [(1974-1980)(1981-1987)(1988-1995)(1996-2003)]. Statistical analyses were performed with SPSS statistical software version 24.

3.5 Ethical Aspects

The project manager had obtained necessary approvals the Regional Committee for Medical Research Ethics (REK), the National Data Inspection Board, and the Norwegian Directorate of Health. The data has been summarized in order to keep complete participant's anonymity.

4. Results

The **analytical population** in this study was 577,326 participants, they had no missing information in any of the studied variables. The population consisted of 48.2% males (n = 278,367) and 51.8% females (n = 298,959). Tables 2 and 3 show that during the first period, around 3% of the smoking males and females were less than 25 years, and around 65% were 37- 47 years. Meanwhile in the last period <0.5% smoking males and females were in the youngest age group, and around 77% of them were 37- 47 years old.

Table 2. Age at enrollment of the male studied population[a] extracted from The Norwegian Counties Study, The 40 years Cohort and the Cohort of Norway (CONOR) Study. (1974- 2003). Stratified by inclusion date and smoking status. (n =278,367).

Inclusion Date	**1974- 1980** (n = 29031) ***9.7%***			**1981- 1987** (n = 16652) ***5.6%***			**1988-1995** (n = 125598) ***45.7%***			**1996-2003** (n = 107086) ***39%***			**All 1974- 2003** (n = 278,367)
Smoking Status	Never (n = 6864) ***22.9%***	Former (n = 6507) ***23.1%***	Current (n = 15660) ***53.9%***	Never (n = 5222) ***30.3%***	Former (n = 4152) ***25.9%***	Current (n = 7278) ***43.8%***	Never (n = 39434) ***31.3%***	Former (n = 33627) ***27.3%***	Current (n = 52537) ***41.6%***	Never (n = 41908) ***37.7%***	Former (n = 29291) ***28.9%***	Current (n = 35887) ***33.4%***	
Age at enrollment													
15- 25 years	470 ***2.5%***	163 ***.9%***	833 ***1.9%***	549 ***3.9%***	95 ***.8%***	451 ***2.2%***	200 ***.2%***	30 ***.0%***	217 ***.1%***	960 ***.8%***	143 ***.2%***	369 ***.3%***	4480 ***.5%***
26- 36 years	1723 ***18.6%***	1351 ***14.5%***	3577 ***16.4%***	455 ***6.4%***	251 ***4.1%***	574 ***5.6%***	553 ***.9%***	254 ***.5%***	751 ***.9%***	6033 ***9.8%***	1795 ***3.8%***	3084 ***5.6%***	20401 ***4.9%***
37- 47 years	4062 ***65.7%***	4151 ***66.6%***	9385 ***64.6%***	4131 ***87.3%***	3708 ***91.8%***	6078 ***88.8%***	36927 ***93%***	29355 ***84.2%***	48631 ***91.5%***	29533 ***71.9%***	18846 ***60%***	26995 ***74.1%***	221802 ***79.5%***
+ 48 years	609 ***13.1%***	842 ***18%***	1865 ***17.1%***	87 ***2.5%***	98 ***3.2%***	175 ***3.4%***	1754 ***5.9%***	3988 ***15.3%***	2938 ***7.4%***	5382 ***17.5%***	8507 ***36.1%***	5439 ***19.9%***	31684 ***15.1%***

Table 3. Age at enrollment of the female studied population[a] extracted from The Norwegian Counties Study, The 40 years Cohort and the Cohort of Norway (CONOR) Study. (1974- 2003). Stratified by inclusion date and smoking status (n = 298,959).

Inclusion Date	**1974- 1980** (n = 24832) ***8.8%***			**1981- 1987** (n = 17106) ***5.4%***			**1988-1995** (n = 133517) ***45.3%***			**1996-2003** (n = 119768) ***40.5%***			**All 1974- 2003** (n = 298,959)
Smoking Status	Never (n = 13614) ***49.2%***	Former (n = 3736) ***12.8%***	Current (n = 11218) ***38%***	Never (n = 7392) ***43.4%***	Former (n = 3026) ***17.8%***	Current (n = 6688) ***38.8%***	Never (n = 52318) ***39.7%***	Former (n = 27471) ***20.5%***	Current (n = 53728) ***39.8%***	Never (n = 48792) ***40.8%***	Former (n = 28900) ***24.5%***	Current (n = 42076) ***34.7%***	
Age at enrollment													
15- 25 years	476 ***1.2%***	211 ***2.1%***	925 ***3.1%***	474 ***2.3%***	146 ***1.7%***	456 ***2.4%***	193 ***.1%***	51 ***.1%***	237 ***.1%***	1036 ***.7%***	191 ***.2%***	448 ***.4%***	4884 ***.5%***
26- 36 years	2704 ***13.9%***	1005 ***19.7%***	2795 ***18.5%***	518 ***5%***	298 ***7%***	602 ***6.4%***	541 ***.7%***	366 ***.9%***	877 ***1.1%***	6239 ***8.4%***	2392 ***5.4%***	4204 ***6.7%***	22541 ***5%***
37- 47 years	8615 ***66.3%***	2111 ***62.1%***	6368 ***63.4%***	6223 ***89.4%***	2523 ***88.6%***	5508 ***88.5%***	46068 ***85.6%***	25363 ***91%***	50591 ***93.8%***	31153 ***63%***	21347 ***72%***	32390 ***77%***	238260 ***79.6%***
+ 48 years	1819 ***18.7%***	409 ***16.1%***	1130 ***15%***	177 ***3.4%***	59 **2.8%**	122 ***2.6%***	5516 ***13.7%***	1691 ***8.1%***	2023 ***5%***	10364 ***27.9%***	4970 ***22.4%***	5034 ***16%***	33314 ***14.8%***

4.1 The Male Population

4.1.1 Univariate Descriptive Analysis

4.1.1.1 Smoking status prevalence from 1974 to 2003

Figure 4 shows that the prevalence of **Current smokers** declined continuously from 53.9% to 33.4%, while there was an increase in the prevalence of **never smokers** from 22.9% to 37.7% and **former smokers** from 23.1% to 28.9%.

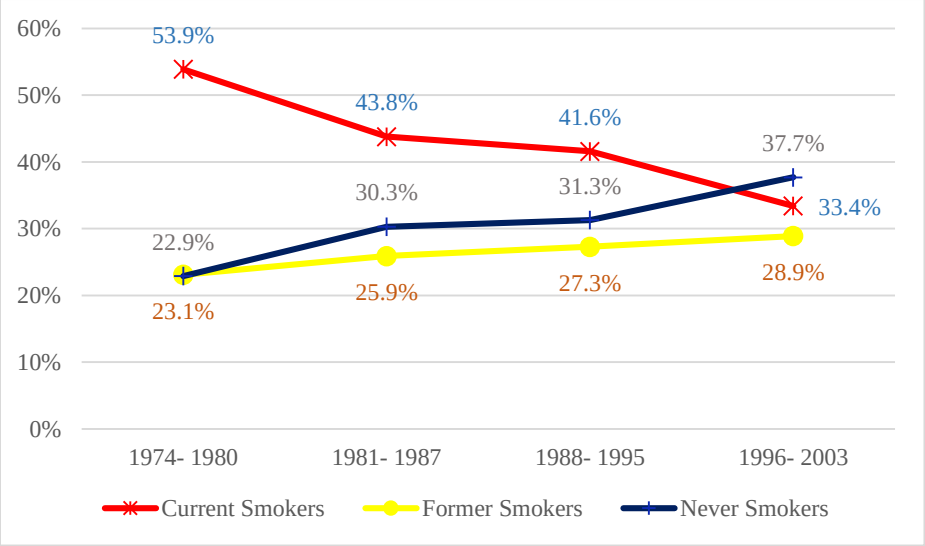

Figure 4. Male Smoking status at enrollment (Current, Former, Never). 1974- 2003. (n = 278,367).

4.1.1.2 Covariates Distribution from 1974 to 2003

Education

Figure 5 shows that the proportion of males with a **high** and **moderate** education level increased from 10.6% to 24.4% and from 42.6% to 58% respectively. Meanwhile, the proportion of males with a **low education** level decreased from 46.9% to 17.6%

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of males with a **high education level** from 6.7% to 14.9% (Table 4).

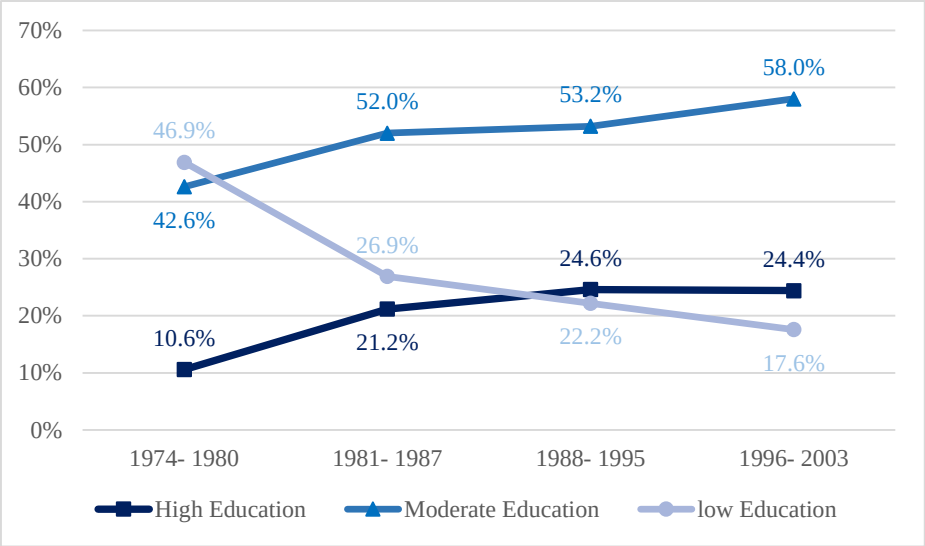

Figure 5. Male Education level at enrollment (High, moderate, low). 1974- 2003. (n = 278,367).

Income

Figure 6 shows that the proportion of males with a **high** and **low** income increased from 51.1% to 55.4% and from 4.7% to 5.4% respectively. Meanwhile, the proportion of males with a **moderate** income level decreased from 44.2% to 39.2%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of males with **high income** from 48.5% to 50.3% (Table 4).

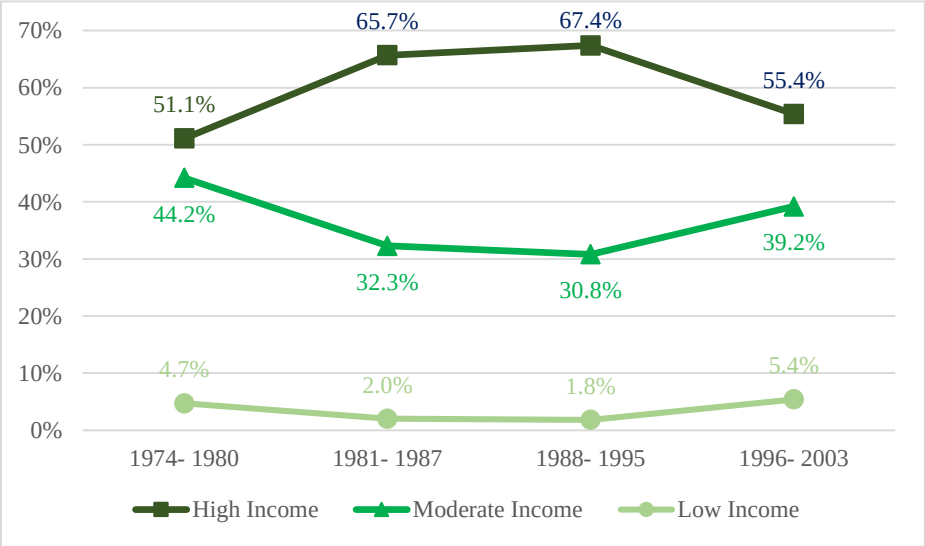

Figure 6. Male Income level at enrollment (High, moderate, low). 1974- 2003. (n = 278,367).

Marital status

Figure 7 shows that the proportion of **single** and **divorced/widowed** males increased from 16.2% to 20.9% and from 2.3% to 11.3% respectively. Meanwhile, the proportion of males **married/cohabiting** decreased from 81.5% to 67.8%.

As for male **current smokers**, from 1974 to 2003 there was an increase in the proportion of **Divorced/widowed** from 3% to 15.7% (Table 4).

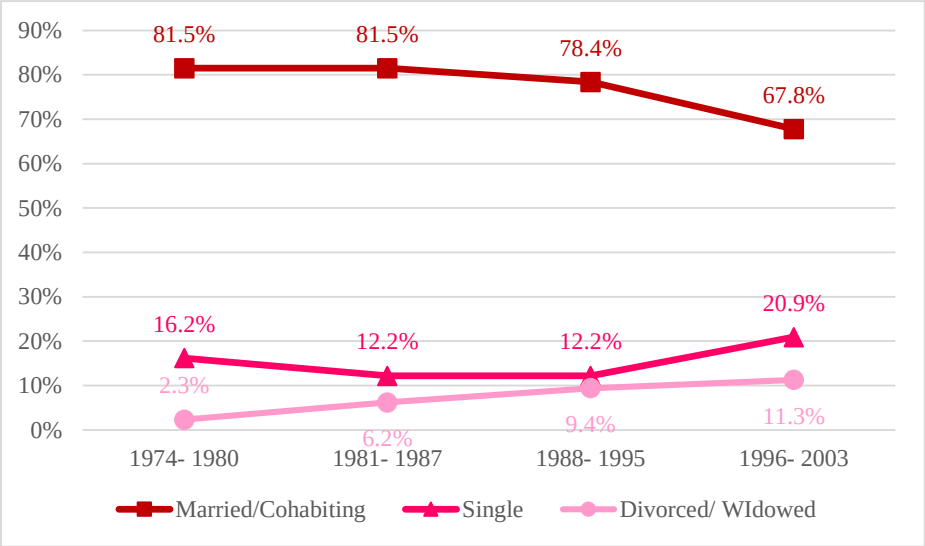

Figure 7. Male marital status at enrollment (Single, Married/cohabiting, Divorced/widowed). 1974- 2003. (n = 278,367).

Body Mass Index

Figure 8 shows that, the proportion of males with a BMI of **25- 30Kg/m^2** and **+30kg/m^2** increased from 40.4% to 49.8% and, from 5.7% to 13.3% respectively. Meanwhile, the proportion of males with a BMI **<25Kg/m^2** decreased from 53.9% to 37%.

As for male **current smokers**, from 1974 to 2003 there was an increase in the proportion of males with a BMI of **+30 Kg/m^2** from 5.2% to 11.2% (Table 5).

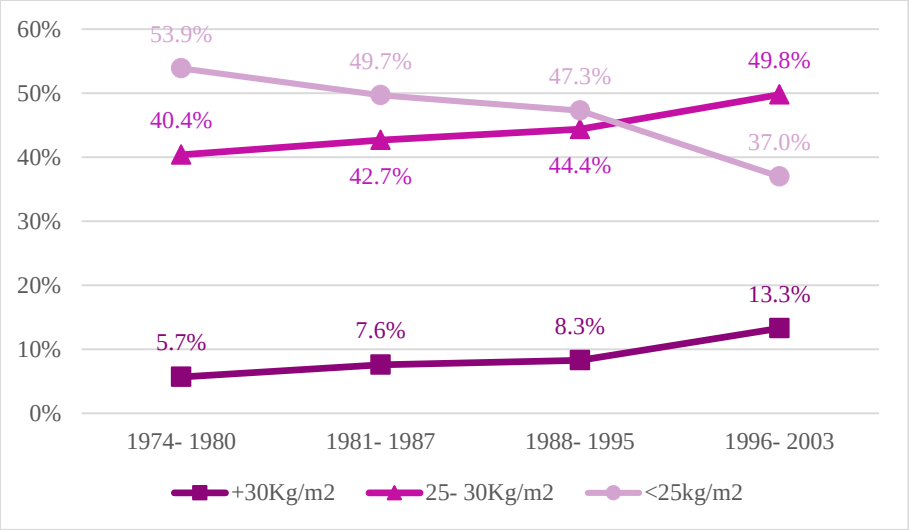

Figure 8. Male Body Mass Index (+30Kg/m^2, 25- 30 Kg/m^2, <25 Kg/m^2). 1974- 2003. (n = 278,367)

Physical activity

Figure 9 shows that the proportion of **sedentary** males, and males that practiced **moderate** physical activity, decreased from 18.2% to 17.2% and from 79.7% to 52.9% respectively. Meanwhile, the proportion of males that practiced **heavy** physical activity dramatically increased from 2.1% to 29.9%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of males practicing **heavy physical activity** from 1.2% to 24.2% (Table 5).

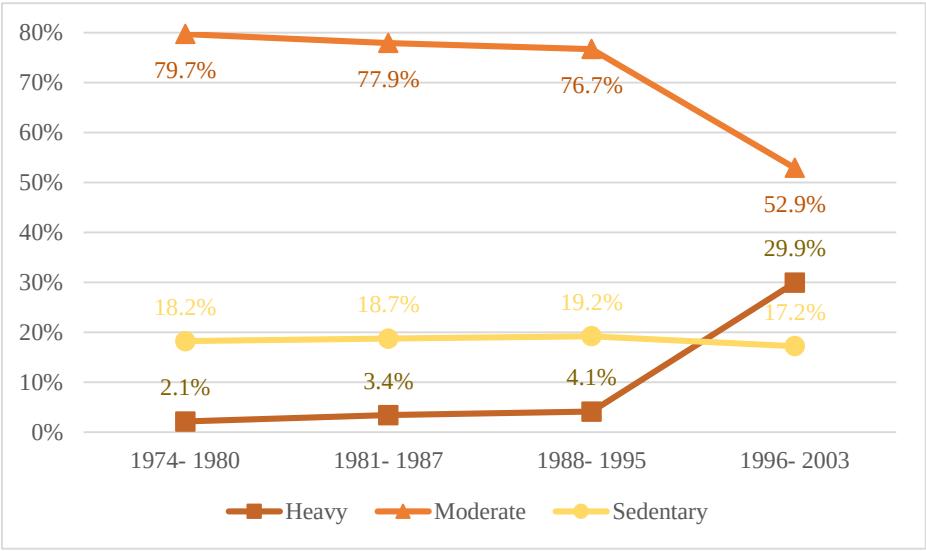

Figure 9. Male physical activity level at enrollment (Heavy, moderate, sedentary). 1974- 2003. (n = 278,367).

4.1.1.3 Smoking status distribution by SES and marital status from 1974 to 2003

Table 4 shows the following distribution for smoking status according to SES and marital status:

Education

In the first period, 17.5% of never smokers and 6.7% of current smokers had a **high education** level, while in the last period the corresponding figures were 34.7% and 14.9%.

Income

In 1974, 56.3% of never smokers and 48.5% of current smokers had a **high income** level, while in 2003, the corresponding figures were 52.1% and 50.3% (table 4).

Marital status

In the first period, 1.2% of never smokers and 3% of current smokers were **Divorced/Widowed**, while in the last period, the corresponding figures were 7.9% and 15.7% (Table 4).

4.1.1.4 Smoking Status distribution by BMI and Physical activity from 1974 to 2003

Table 5 shows the following distribution for smoking status according to BMI and physical activity:

Body Mass Index

In the first period, around < 6% of never and current smokers had a **BMI of +30Kg/m^2**, while in the last period the corresponding figures were 12.6% and 11.2%.

Physical Activity

In the first period, 4.2% of never smokers and 1.2% of current smokers practiced **hard physical activity,** while in the last period the corresponding figures were 34.3% and 24.2%.

Table 4. Univariate analysis[a] of Socio- economic and Marital status characteristics of the Male analytical population (n =278,367). Stratified by inclusion date and smoking status (1974- 2003).

Inclusion Date	**1974- 1980** (n = 29031) ***9.7%***			**1981- 1987** (n = 16652) ***5.6%***			**1988-1995** (n = 125598) ***45.7%***			**1996-2003** (n = 107086) ***39%***			**All 1974- 2003** (n = 278,367)
Smoking Status	Never (n = 6864) ***22.9%***	Former (n = 6507) ***23.1%***	Current (n = 15660) ***53.9%***	Never (n = 5222) ***30.3%***	Former (n = 4152) ***25.9%***	Current (n = 7278) ***43.8%***	Never (n = 39434) ***31.3%***	Former (n = 33627) ***27.3%***	Current (n = 52537) ***41.6%***	Never (n = 41908) ***37.7%***	Former (n = 29291) ***28.9%***	Current (n = 35887) ***33.4%***	
Education Level													
Low (0 - 10 years of education)	2253 ***34.9%***	2698 ***43%***	8079 ***53.6%***	872 ***17.3%***	1021 ***24.9%***	2440 ***34.6%***	5229 ***13.5%***	7294 ***22.6%***	14675 ***28.4%***	4262 ***10.4%***	5596 ***20.5%***	8024 ***23.1%***	62443 ***25.6%***
Moderate (11 - 13 years of education)	3318 ***47.7%***	2948 ***44.3%***	6443 ***39.6%***	2748 ***51.1%***	2219 ***53%***	3875 ***51.9%***	19337 ***48.8%***	18233 ***53.7%***	29696 ***56.1%***	23539 ***54.9%***	17239 ***57.6%***	22606 ***61.9%***	152201 ***54.3%***
High (13+ years of education)	1293 ***17.5%***	861 ***12.7%***	1138 ***6.7%***	1602 ***31.5%***	912 ***22.1%***	963 ***13.5%***	14868 ***37.6%***	8100 ***23.1%***	8166 ***15.5%***	14107 ***34.7%***	6456 ***22%***	5257 ***14.9%***	63723 ***20.1%***

Income (Total household income)												
Low	226 ***3.3%***	212 ***3.2%***	840 ***5.4%***	127 ***2.4%***	58 ***1.4%***	169 ***2.3%***	675 ***1.7%***	513 ***1.5%***	1089 ***2.1%***	4239 ***10.1%***	1493 ***5.1%***	2146 ***6%***	11787 ***3.5%***
Moderate	2778 ***40.4%***	2615 ***40.1%***	7230 ***46.1%***	1713 ***32.8%***	1260 ***30.3%***	2666 ***36.6%***	10765 ***27.3%***	9829 ***29.3%***	18004 ***34.4%***	15836 ***37.8%***	10968 ***37.4%***	15710 ***43.8%***	99374 ***35.4%***
High	3860 ***56.3%***	3680 ***56.6%***	7590 ***48.5%***	3382 ***64.8%***	2834 ***68.3%***	4443 ***61.1%***	27994 ***71%***	23285 ***69.2%***	33444 ***63.5%***	21833 ***52.1%***	16830 ***57.5%***	18031 ***50.3%***	167206 ***61%***
Marital Status												
Single	1634 ***20.4%***	760 ***10.6%***	3011 ***16.8%***	1187 ***16.6%***	356 ***7%***	1160 ***12.3%***	5799 ***14.2%***	2870 ***8.3%***	7151 ***13.1%***	11700 ***24.2%***	4736 ***14.1%***	9137 ***22.9%***	49501 ***15.9%***
Married/ Cohabiting	5150 ***78.4%***	5647 ***87.9%***	12186 ***80.2%***	3876 ***80%***	3607 ***88.3%***	5500 ***78.6%***	31263 ***79.7%***	28279 ***84.2%***	38514 ***73.7%***	27161 ***67.9%***	21552 ***75.1%***	21370 ***61.4%***	204105 ***74.8%***
Divorced/ Widowed	80 ***1.2%***	100 ***1.5%***	463 ***3%***	159 ***3.4%***	189 ***4.7%***	618 ***9.1%***	2372 ***6.1%***	2478 ***7.5%***	6872 ***13.2%***	3047 ***7.9%***	3003 ***10.8%***	5380 ***15.7%***	24761 ***9.3%***

a. Adjusted for age at enrolment.

Table 5. Univariate analysis [a] of Life- style characteristics of the Male analytical population (n =278,367). Stratified by inclusion date and smoking status (1974- 2003).

Inclusion Date	**1974- 1980** (n = 29031) ***9.7%***			**1981- 1987** (n = 16652) ***5.6%***			**1988-1995** (n = 125598) ***45.7%***			**1996-2003** (n = 107086) ***39%***			**TOTAL All 1974- 2003** (n = 278,367)
Smoking Status	Never (n = 6864) ***22.9%***	Former (n = 6507) ***23.1%***	Current (n = 15660) ***53.9%***	Never (n = 5222) ***30.3%***	Former (n = 4152) ***25.9%***	Current (n = 7278) ***43.8%***	Never (n = 39434) ***31.3%***	Former (n = 33627) ***27.3%***	Current (n = 52537) ***41.6%***	Never (n = 41908) ***37.7%***	Former (n = 29291) ***28.9%***	Current (n = 35887) ***33.4%***	
BMI													
< 25 kg/m^2	3783 ***52.9%***	3018 ***45%***	9329 ***58.1%***	2782 ***51%***	1725 ***40.6%***	4044 ***54.2%***	18994 ***48%***	13121 *38.8%*	27596 ***52.4%***	16118 ***37.5%***	8673 ***28.8%***	15694 ***43.4%***	124877 ***44%***
25- 30 kg/m^2	2720 ***41.4%***	3052 ***48%***	5543 ***36.7%***	2098 ***42.1%***	2049 ***50%***	2745 ***38.8%***	17260 ***44%***	17113 ***51%***	21153 ***40.3%***	20615 ***49.8%***	15903 ***54.7%***	16219 ***45.5%***	126470 ***46%***
+ 30 kg/m^2	361 ***5.7%***	437 ***7%***	788 ***5.2%***	342 ***6.9%***	378 ***9.3%***	489 ***7.1%***	3180 ***8.1%***	3393 ***10.2%***	3788 ***7.2%***	5175 *12.6%*	4715 ***16.6%***	3974 ***11.2%***	27020 ***10%***

Level Physical Activity													
Sedentary (reading, watching tv)	1010 ***15%***	1022 ***15.7%***	3267 ***20.6%***	695 ***13.7%***	637 ***15.5%***	1732 ***24%***	5988 ***15.2%***	5427 ***16.1%***	12683 ***24.1%***	5885 ***14.2%***	4645 ***16%***	7706 ***21.6%***	50697 ***18.3%***
Moderate (activities ≥ 4 hours a week)	5503 ***80.8%***	5312 ***82%***	12147 ***78.2%***	4132 ***80.1%***	3359 ***80.9%***	5409 ***74.6%***	31016 ***78.9%***	26625 ***79.2%***	38549 ***73.5%***	21216 ***51.5%***	15482 ***53.3%***	19292 ***54.2%***	188042 ***67.8%***
Heavy (hard exercise regularly)	351 ***4.2%***	173 ***2.3%***	246 ***1.2%***	395 ***6.1%***	156 ***3.5%***	137 ***1.4%***	2430 ***6%***	1575 ***4.7%***	1305 ***2.4%***	14807 ***34.3%***	9164 ***30.7%***	8889 ***24.2%***	39628 ***13.9%***

a. Adjusted for age at enrolment.

4.1.2 Multivariate logistic Regression Analysis

When current and former smokers were compared with never smokers according to Socio-economic and Lifestyle characteristics (we used as reference groups participants in the low education, low income, BMI of <25Kg/m^2, sedentary and married/cohabiting categories) the following results were obtained:

Current Smokers

Table 6 shows that, males included in the first period **(1974- 1980),** were **less likely to be current smokers,** if they were in the **upper category** of **education** (OR = 0.24, 95% CI 0.21- 0.26), **income** (OR = 0.72, 95% CI 0.61- 0.85), **BMI** (OR = 0.70, 95% CI 0.61- 0.80), **physical activity** (OR = 0.24, 95% CI 0.20- 0.29) and, were **Single** (OR = 0.65, 95% CI 0.60- 0.71). In contrast, males were **more likely to be smokers** when were **divorced/widowed** (OR = 2.36, 95% CI 1.85- 3.02).

In the latter period of inclusion **(1996- 2003)**, males were **less likely to be current smokers** if they were in the **upper category** of **education** (OR = 0.18, 95% CI 0.17- 0.19), **BMI** (OR = 0.61, 95% CI 0.58- 0.64) and **physical activity** (OR = 0.53, 95% CI 0.50- 0.55). In contrast, males were **more likely to be smokers** when were **divorced/widowed** (OR = 2.04, 95% CI 1.94- 2.15), **Single** (OR = 1.11, 95% CI 1.07- 1.15), and in the upper category of **income** (OR = 1.38, 95% CI 1.28- 1.48).

Former Smokers

Table 7 shows that, males that were included in the first period **(1974- 1980)**, were **less likely to be former smokers,** if they were in the **upper category** of **education** (OR = 0.55, 95% CI

0.49- 0.62), **income** (OR = 0.96, 95% CI 0.78- 1.18), **physical activity** (OR = 0.62, 95% CI 0.50- 0.76) and were S**ingle** (OR = 0.44, 95% CI 0.40- 0.49).

In contrast, males were **more likely to be former smokers** when were **divorced/widowed** (OR = 1.12, 95% CI 0.83- 1.52) and in the upper category of **BMI** (OR = 1.29, 95% CI 1.11- 1.50)

In the latter period of inclusion **(1996- 2003)**, males were **less likely to be former smokers** if they were in the **upper category** of **education** (OR = 0.37, 95% CI 0.35- 0.39), **physical activity** (OR = 0.95, 95% CI 0.90- 1.00) and were **Single** (OR = 0.67, 95% CI 0.64- 0.70).

In contrast, males were **more likely to be former smokers** when **divorced/widowed** (OR = 1.09, 95% CI 1.03- 1.15) and, in the upper category of **income** (OR = 1.24, 95% CI 1.15- 1.35) and **BMI** (OR = 1.35, 95% CI 1.28- 1.42).

Table 6. Multivariable [a, b] Odd ratios (ORs) with 95% confidence intervals (Ci's) for Current Smokers compared with Never smokers according to selected Socio- economic and Lifestyle characteristics by calendar time period for study enrolment among Norwegian males (n = 204,790). (1974- 2003).

Inclusion Date		**1974- 1980** (n = 22524) ***10.2%***			**1981- 1987** (n = 12500) ***5.7%***			**1988-1995** (n = 91971) ***45.8%***			**1996-2003** (n = 77795) ***38.2%***			**All 1974- 2003** (204,790)		
Covariates		**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**
Education	Low	8079	1	N.A.	2440	1	N.A	14675	1	N.A	8024	1	N.A.	33218	1	N.A.
	Moderate	6443	0.53	0.50- 0.57	3875	0.51	0.47- 0.57	29696	0.54	0.52- 0.56	22606	0.51	0.49- 0.53	62620	0.49	0.48- 0.50
	High	1138	0.24	0.21- 0.26	963	0.20	0.18- 0.23	8166	0.19	0.18- 0.19	5257	0.18	0.17- 0.19	15524	0.17	0.17- 0.18
Income	Low	840	1	N.A.	169	1	N.A.	1089	1	N.A.	2146	1	N.A.	4244	1	N.A.
	Moderate	7230	0.74	0.63- 0.87	2666	1.12	0.87- 1.46	18004	1.06	0.95- 1.18	15710	1.35	1.26- 1.45	43610	1.45	1.38- 1.52
	High	7590	0.72	0.61- 0.85	4443	1.17	0.90- 1.52	33444	1.02	0.92- 1.14	18031	1.38	1.28- 1.48	63508	1.49	1.42- 1.56
Marital Status	Married/ cohabiting	12186	1	N.A.	5500	1	N.A.	38514	1	N.A.	21370	1	N.A.	77570	1	N.A.
	Single	3011	0.65	0.60- 0.71	1160	0.65	0.58- 0.74	7151	0.85	0.82- 0.89	9137	1.11	1.07- 1.15	20459	0.88	0.88- 0.90
	Divorced/ Widowed	463	2.36	1.85- 3.02	618	2.46	2.04- 2.96	6872	2.18	2.07- 2.30	5380	2.04	1.94- 2.15	13333	2.02	1.95- 2.09

BMI	<25Kg/m^2	9329	1	N.A.	4044	1	N.A.	27596	1	N.A.	15694	1	N.A.	56663	1	N.A.
	25-30Kg/m^2	5543	0.72	0.68- 0.77	2745	0.73	0.68- 0.80	21153	0.75	0.73- 0.78	16219	0.72	0.70- 0.74	45660	0.71	0.70- 0.73
	+30Kg/m^2	788	0.70	0.61- 0.80	489	0.68	0.58- 0.79	3788	0.62	0.59- 0.65	3974	0.61	0.58- 0.64	9039	0.59	0.57- 0.61
Physical Activity	Sedentary	3267	1	N.A.	1732	1	N.A.	12683	1	N.A.	7706	1	N.A.	25388	1	N.A.
	Moderate	12147	0.68	0.63- 0.74	5409	0.51	0.46- 0.57	38549	0.58	0.56- 0.60	19292	0.73	0.70- 0.76	75397	0.65	0.63- 0.67
	Heavy	246	0.24	0.20- 0.29	137	0.16	0.13- 0.20	1305	0.23	0.22- 0.25	8889	0.53	0.50- 0.55	10570	0.35	0.34- 0.37

a. Adjusted for age at enrolment.
b. All variables are adjusted for each other (education, income, marital status, BMI and physical activity).

Table 7. Multivariable [a, b] Odd ratios (ORs) with 95% confidence intervals (Ci's) for Former Smokers compared with Never smokers according to selected Socio- economic and Lifestyle characteristics by calendar time period for study enrolment among Norwegian males (n = 167,005). (1974- 2003).

Inclusion Date	**1974- 1980** (n = 13371) ***7.4%***			**1981- 1987** (n = 9374) ***5.2%***			**1988-1995** (n = 73061) ***44.3%***			**1996-2003** (n = 71199) ***43.1%***			**All 1974- 2003** (n = 167,005)		
Covariates	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**
Education	Low	2698	1	N.A.	1021	1	N.A	7294	1	N.A	5596	1	N.A.	16609	1	N.A.
	Moderate	2948	0.74	0.68- 0.80	2219	0.70	0.63- 0.79	18233	0.72	0.69- 0.75	17239	0.65	0.62- 0.69	40639	0.67	0.65- 0.69
	High	861	0.55	0.49- 0.62	912	0.45	0.40- 0.52	8100	0.42	0.40- 0.44	6456	0.37	0.35- 0.39	16329	0.39	0.38- 0.40

Income	Low	212	1	N.A.	58	1	N.A.	513	1	N.A.	1493	1	N.A.	2276	1	N.A.
	Moderate	2615	0.88	0.72- 1.08	1260	1.15	0.82- 1.63	9829	1.15	1.01- 1.31	10968	1.14	1.05- 1.23	24672	1.24	1.17- 1.31
	High	3680	0.96	0.78- 1.18	2834	1.29	0.91- 1.82	23285	1.22	1.07- 1.39	16830	1.24	1.15- 1.35	46629	1.38	1.30- 1.47
Marital Status	Married/ cohabiting	5647	1	N.A.	3607	1	N.A.	28279	1	N.A.	21552	1	N.A.	59085	1	N.A.
	Single	760	0.44	0.40- 0.49	356	0.42	0.36- 0.49	2870	0.53	0.50- 0.56	4736	0.67	0.64- 0.70	8722	0.56	0.54- 0.58
	Divorced/ Widowed	100	1.12	0.83- 1.52	189	2.21	0.97- 1.51	2478	1.09	1.03- 1.16	3003	1.09	1.03- 1.15	5770	1.07	1.02- 1.11
BMI	<25Kg/m^2	3018	1	N.A.	1725	1	N.A.	13121	1	N.A.	8673	1	N.A.	26537	1	N.A.
	25-30Kg/m^2	3052	1.22	1.14- 1.32	2049	1.28	1.17- 1.40	17113	1.31	1.26- 1.35	15903	1.24	1.20- 1.28	38117	1.24	1.22- 1.27
	+30Kg/m^2	437	1.29	1.11- 1.50	378	1.41	1.19- 1.66	3393	1.36	1.28- 1.43	4715	1.35	1.28- 1.42	8923	1.30	1.26- 1.35
Physical Activity	Sedentary	1022	1	N.A.	637	1	N.A.	5427	1	N.A.	4645	1	N.A.	11731	1	N.A.
	Moderate	5312	0.95	0.86- 1.05	3359	0.92	0.81- 1.04	26625	0.96	0.92- 1.00	15482	0.97	0.93- 1.01	50778	0.97	0.95- 1.00
	Heavy	173	0.62	0.50- 0.76	156	0.62	0.50- 0.78	1575	0.76	0.70- 0.82	9164	0.95	0.90- 1.00	11068	0.81	0.78- 0.84

a. Adjusted for age at enrolment.
b. All variables are adjusted for each other (education, income, marital status, BMI and physical activity).

4.2 The female population

4.2.1 Univariate Descriptive Analysis

4.2.1.1 Smoking status prevalence from 1974 to 2003

From 1974 to 2003, the female prevalence of **current** smokers and **never** smokers declined from 39.3% to 35.1% and 47.6% to 40.7% respectively. In contrast, there was an increase in the prevalence of **former** smokers from 13.1% to 24.1% (Figure 10).

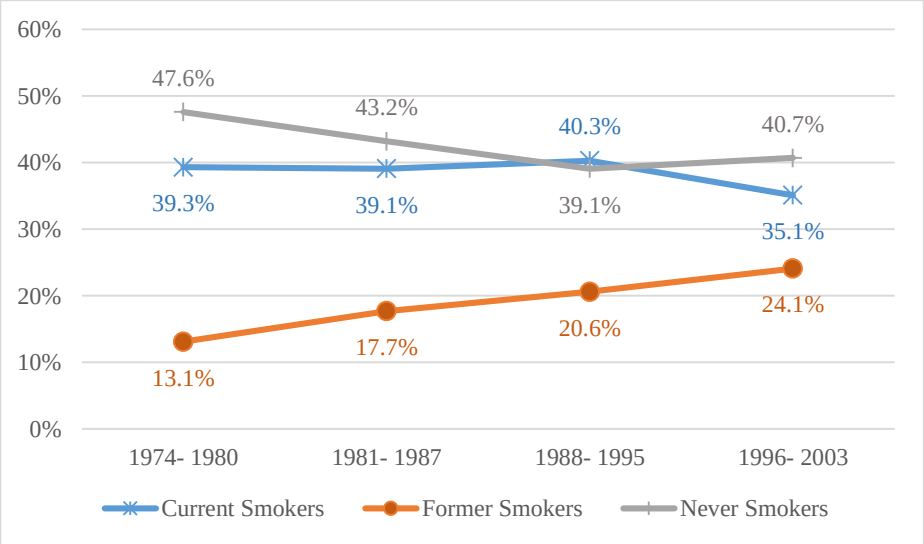

Figure 10. Female Smoking status at enrollment (Current, Former, Never). 1974- 2003. (n = 298,959).

4.2.1.2 Covariates distribution from 1974 to 2003

Education

Figure 11 shows that the proportion of females with a **high** and **moderate** education level continuously increased from 8.5% to 23.4% and from 41.7% to 57% respectively. Meanwhile, the proportion of females with a **low education** level decreased from 49.8% to 19.6%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of females with a **high education level** from 5.1% to 12.6% (Table 8).

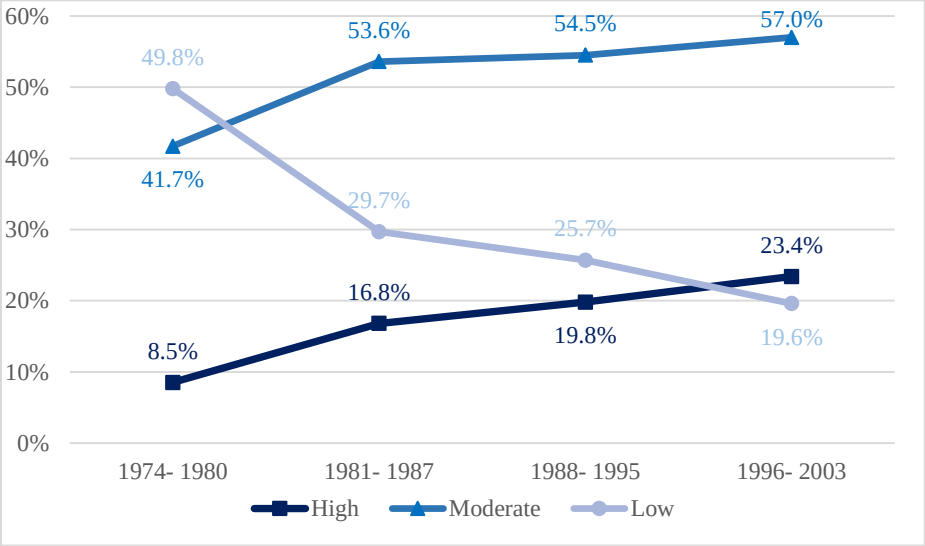

Figure 11. Female Education level at enrollment (High, moderate, low). 1974- 2003. (n = 298,959).

Income

Figure 12 shows that the proportion of females with a **high** and **moderate** income increased from 7.4% to 9.5% and from 66.4% to 70.7% respectively. Meanwhile, the proportion of females with a **low** income level decreased from 26.2% to 19.8%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of females with a **moderate income level** from 70.2% to 72.4% (Table 8).

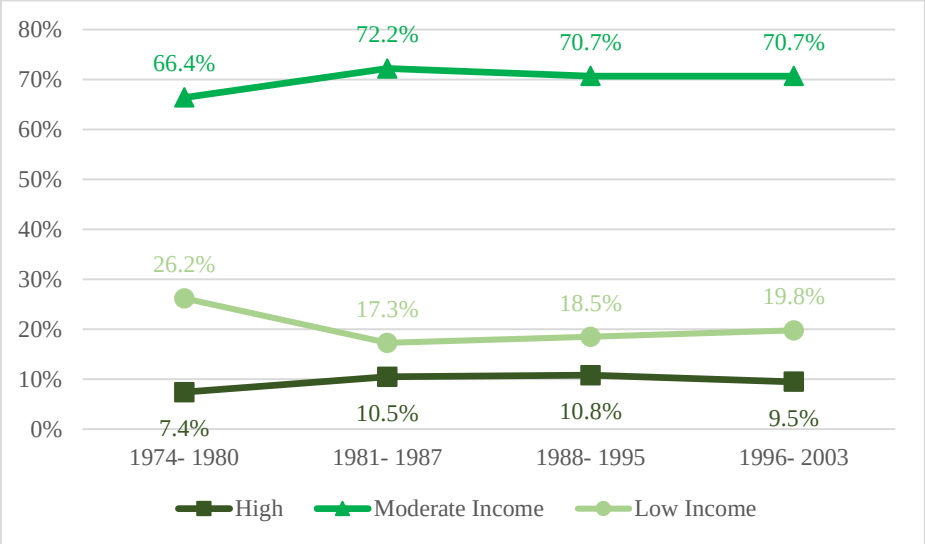

Figure 12. Female Income level at enrollment (High, moderate, low). 1974- 2003. (n = 298,959).

Marital status

Figure 13 shows that the proportion of **single** and **divorced/widowed** females increased from 6.8% to 14.5% and from 4.8% to 18.1% respectively. Meanwhile, the proportion of females **married/cohabiting** decreased from 88.4% to 67.4%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of females **divorced/widowed** from 7% to 23% (Table 8).

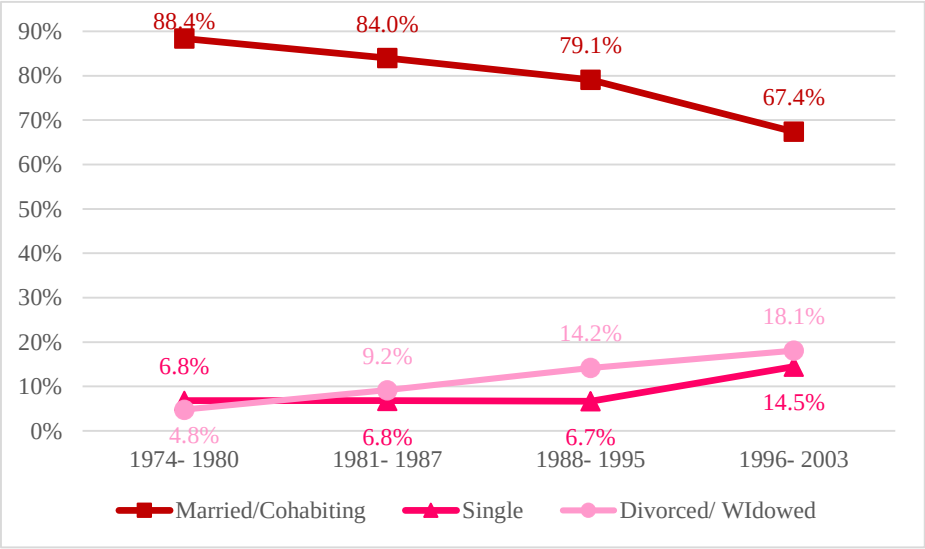

Figure 13. Female marital status at enrollment (Single, Married/cohabiting, Divorced/widowed). 1974- 2003. (n = 298,959).

Body Mass Index

Figure 14 shows that, the proportion of females with a BMI of **25- 30Kg/m^2** and **+30kg/m^2** increased from 27.1% to 31.4% and, from 10.1% to 12.9% respectively. Meanwhile, the proportion of females with a BMI **<25Kg/m^2** decreased from 62.7% to 55.7%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of females with a BMI of +**30Kg/m^2** from 7.6% to 10.1% (Table 9).

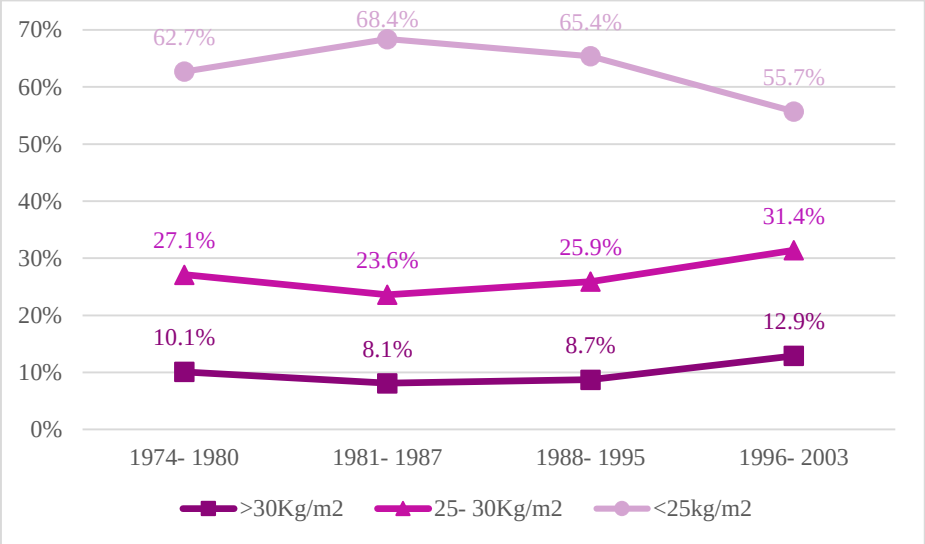

Figure 14. Female Body Mass Index (+30Kg/m^2, 25- 30 Kg/m^2, <25 Kg/m^2). 1974- 2003. (n = 298,959).

Physical activity

Figure 15 shows that the proportion of **sedentary** females, and females that practiced **moderate** physical activity, decreased from 22.3% to 16.9% and from 77.5% to 61.1% respectively. Meanwhile, the proportion of females that practiced **heavy** physical activity increased from 0.2% to 22.1%.

As for **current smokers**, from 1974 to 2003 there was an increase in the proportion of females that practiced **heavy physical activity** from 0.2% to 19% (Table 9).

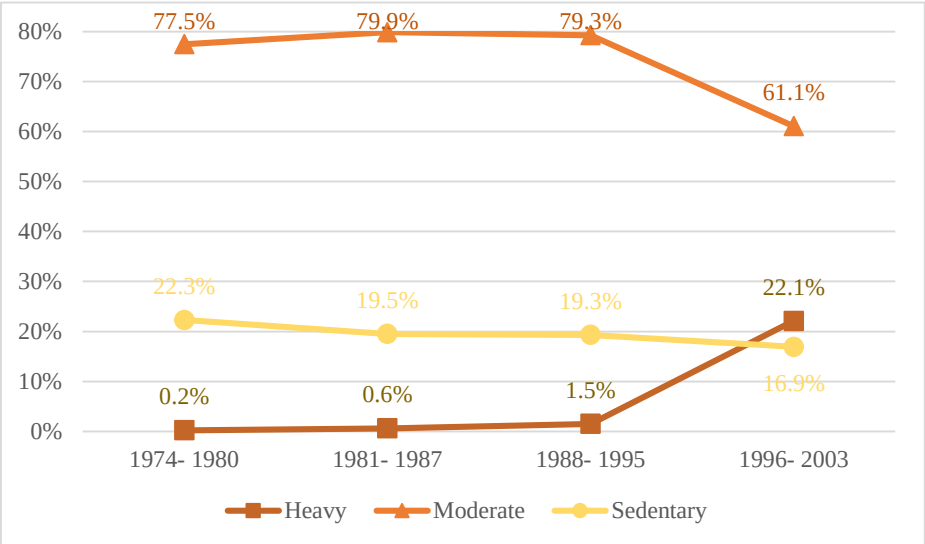

Figure 15. Female physical activity level at enrollment (Heavy, moderate, sedentary). 1974- 2003. (n = 298,959).

4.2.1.3 Smoking status distribution by SES and marital status from 1974 to 2003

Table 8 shows the following distribution for smoking status according to SES and marital status:

Education

In the first period, 10.3% of never smokers and 5.1% of current smokers had a **high education** level, while in the last period the corresponding figures were 32.3% and 12.6%.

Income

In 1974, 65.3% of never smokers and 70.2% of current smokers had a **moderate income** level, while in 2003, the corresponding figures were 66.1% and 72.4%.

Marital status

In the first period, 3.3% of never smokers and 7% of current smokers were **Divorced/Widowed**, while in the last period, the corresponding figures were 15.1% and 23%.

4.2.1.4 Smoking status distribution by BMI and physical activity from 1974 to 2003

Table 9 shows the following distribution for smoking status according to BMI and physical activity:

Body Mass Index

In the first period, 12.3% of never and 7.6% of current smokers had a **BMI of +30Kg/m^2**, while in the last period the corresponding figures were 14.8% and 10.1%.

Physical Activity

In the first period, 0.2% of never smokers and current smokers practiced **hard physical activity,** while in the last period the corresponding figures were 23.1% and 19%.

Table 8. Univariate analysis[a] of Socio- economic and Marital status characteristics of the Female analytical population (n = 298,959). Stratified by inclusion date and smoking status (1974- 2003).

Inclusion Date	**1974- 1980** (n = 28568) ***8.8%***			**1981- 1987** (n = 17106) ***5.4%***			**1988-1995** (n = 133517) ***45.3%***			**1996-2003** (n = 119768) ***40.5%***			**All 1974- 2003** (n = 298,959)
Smoking Status	Never (n = 13614) ***49.2%***	Former (n = 3736) ***12.8%***	Current (n = 11218) ***38%***	Never (n = 7392) ***43.4%***	Former (n = 3026) ***17.8%***	Current (n = 6688) ***38.8%***	Never (n = 52318) ***39.7%***	Former (n = 27471) ***20.5%***	Current (n = 53728) ***39.8%***	Never (n = 48792) ***40.8%***	Former (n = 28900) ***24.5%***	Current (n = 42076) ***34.7%***	
Education Level													
Low (0 - 10 years)	5925 ***45.9%***	1608 ***45.3%***	6004 ***56.3%***	1530 ***21.8%***	825 ***28.1%***	2517 ***39.2%***	9741 ***20%***	5881 ***22.1%***	17704 ***33.4%***	7233 ***16.3%***	4632 ***17.3%***	10191 ***25.2%***	73791 ***25.6%***
Moderate (11-13 Years)	6145 ***43.9%***	1671 ***43.2%***	4583 ***38.5%***	4106 ***54.8%***	1666 ***53.8%***	3591 ***52.1%***	27474 ***51.9%***	15561 ***56.2%***	30338 ***56.1%***	25602 ***51.4%***	17302 ***58.8%***	26610 ***62.2%***	164649 ***54.3%***
High (13+ years)	1544 ***10.3%***	457 ***11.5%***	631 ***5.1%***	1756 ***23.4%***	535 ***18%***	580 ***8.7%***	15103 ***28.1%***	6029 ***21.7%***	5686 ***10.5%***	15957 ***32.3%***	6966 ***23.9%***	5275 ***12.6%***	60519 ***20.1%***

Income (total household income)													
Low	3672 **27%**	777 ***20.9%***	2512 ***22.4%***	1294 ***17.5%***	458 ***15.1%***	1218 ***18.2%***	10144 ***19.4%***	4388 ***16%***	9623 ***17.9%***	11793 ***24.2%***	5061 ***17.5%***	8607 ***20.5%***	59547 ***19.6%***
Moderate	8895 **65.3%**	2602 ***69.6%***	7874 ***70.2%***	5222 ***70.7%***	2231 ***73.7%***	4942 ***73.9%***	35758 ***68.3%***	19797 ***72.1%***	39370 ***73.3%***	32260 ***66.1%***	20905 ***72.3%***	30465 ***72.4%***	210321 ***70.4%***
High	1047 **7.7%**	357 ***9.6%***	832 ***7.4%***	876 ***11.8%***	337 ***11.2%***	528 ***7.9%***	6416 ***12.3%***	3286 ***12%***	4735 ***8.8%***	4739 ***9.7%***	2934 ***10.2%***	3004 ***7.1%***	29091 ***9.9%***
Marital Status													
Single	1186 ***7.5%***	236 ***4.9%***	1000 ***6.5%***	829 ***8.1%***	215 ***5%***	632 ***6.2%***	3929 ***7.2%***	1550 ***5.4%***	3951 ***6.9%***	8664 ***14.3%***	4103 ***12.2%***	7947 ***16.4%***	34242 ***9.9%***
Married/ Cohabiting	12008 ***89.2%***	3359 ***91.1%***	9486 ***86.5%***	6174 ***86.3%***	2577 ***86.8%***	5204 ***80.1%***	43208 ***82.4%***	22718 ***82.6%***	39668 ***74%***	33670 ***70.6%***	20473 ***71.6%***	24916 ***60.6%***	223461 ***75.4%***
Divorced/ Widowed	420 ***3.3%***	141 ***4%***	732 ***7%***	389 ***5.6%***	234 ***8.2%***	852 ***13.7%***	5181 ***10.4%***	3203 ***12%***	10109 ***19.1%***	6458 ***15.1%***	4324 ***16.1%***	9213 ***23%***	41256 ***14.7%***

a. Adjusted for age at enrolment.

Table 9. Univariate analysis[a] of the Life- style characteristics[a] of the Female analytical population (n = 298,959). Stratified by inclusion date and smoking status (1974-2003).

Inclusion Date	**1974- 1980** (n = 28568) ***8.8%***			**1981- 1987** (n = 17106) ***5.4%***			**1988-1995** (n = 133517) ***45.3%***			**1996-2003** (n = 119768) ***40.5%***			**All 1974- 2003** (n = 298,959)
Smoking Status	Never (n = 13614) ***49.2%***	Former (n = 3736) ***12.8%***	Current (n = 11218) ***38%***	Never (n = 7392) ***43.4%***	Former (n = 3026) ***17.8%***	Current (n = 6688) ***38.8%***	Never (n = 52318) ***39.7%***	Former (n = 27471) ***20.5%***	Current (n = 53728) ***39.8%***	Never (n = 48792) ***40.8%***	Former (n = 28900) ***24.5%***	Current (n = 42076) ***34.7%***	
BMI													
< 25 kg/m^2	8124 ***57.5%***	2444 ***63.2%***	8030 ***69.4%***	4940 ***65.6%***	1996 ***64.8%***	4953 ***73.2%***	32822 ***61.8%***	17294 ***62.4%***	37992 ***70.5%***	26613 ***52.6%***	15470 ***52.3%***	26157 ***61.6%***	186835 ***61.4%***
25- 30 kg/m^2	3932 ***30.2%***	981 ***27.7%***	2412 ***23%***	1812 ***25.3%***	773 ***26.3%***	1318 ***20.3%***	14349 ***27.9%***	7712 ***28.4%***	12099 ***22.7%***	15390 ***32.6%***	9625 ***33.9%***	11725 ***28.3%***	82128 ***28.1%***
30+ kg/m^2	1558 ***12.3%***	311 ***9.1%***	776 ***7.6%***	640 ***9.1%***	257 ***9%***	417 ***6.5%***	5147 ***10.2%***	2465 ***9.2%***	3637 ***6.8%***	6789 ***14.8%***	3805 ***13.8%***	4194 ***10.1%***	29996 ***10.5%***

Level Physical Activity													
Sedentary	2882 ***21.5%***	719 ***18.9%***	2751 ***24.4%***	1148 ***15.8%***	523 ***17.5%***	1589 ***24.4%***	8613 ***16.7%***	4485 ***16.4%***	12314 ***23%***	7306 ***15.9%***	4077 ***14.5%***	8133 ***19.7%***	54540 ***18.5%***
Moderate	10705 ***78.3%***	3003 ***80.8%***	8439 ***75.4%***	6158 ***83.4%***	2474 ***81.5%***	5073 ***75.3%***	42825 ***81.7%***	22393 ***81.4%***	40752 ***75.8%***	29407 ***61.1%***	17408 ***60.6%***	25647 ***61.3%***	214284 ***71.8%***
Heavy	27 ***.2%***	14 ***.3%***	28 ***.2%***	86 ***.8%***	29 ***.9%***	26 ***.2%***	880 ***1.6%***	593 ***2.1%***	662 ***1.2%***	12079 ***23.1%***	7415 ***24.9%***	8296 ***19%***	30135 ***9.7%***

a. Adjusted for age at enrolment.

4.2.2 Multivariate Logistic Regression Analysis

Current Smokers

Females included in the first period **(1974- 1980)**, were **less likely to be current smokers** if in the **upper category** of **education** (OR = 0.25, 95% CI 0.22- 0.28), **BMI** (OR = 0.50, 95% CI 0.45- 0.55), **physical activity** (OR = 0.70, 95% CI 0.40- 1.21) and were **Single** (OR=0.79, 95% CI 0.72-0.88). In contrast, females were **more likely to be smokers** when **divorced/widowed** (OR = 2.26, 95% CI 1.99- 2.56) and in the upper category of **income** (OR=1.82, 95% CI 1.61- 2.06). In the latter period of inclusion **(1996- 2003)**, females were **less likely to be current smokers** if they were in the **upper category** of **education** (OR = 0.14, 95% CI 0.17- 0.19), **BMI** (OR = 0.55, 95% CI 0.52- 0.57) and **physical activity** (OR = 0.66, 95% CI 0.63- 0.69). In contrast, females were **more likely to be smokers** when were **Single** (OR = 1.51, 95% CI 0.63- 0.68), **divorced/widowed** (OR = 1.37, 95% CI 1.30- 1.44) and in the upper category of **income** (OR = 1.63, 95% CI 1.53- 1.73).

Former Smokers

Table 11 shows that females that were included in the first period **(1974- 1980)**, were **less likely to be former smokers** if they were in the **upper category** of **education** (OR = 0.47, 95% CI 0.44- 0.49) and **BMI** (OR=0.94, 95% CI 0.90- 0.99). In contrast, females were **more likely to be former smokers** when were **married/cohabiting** (OR=1.04, 95% CI 0.99-1.09), **divorced/widowed** (OR=1.22, 95% CI 1.15-1.30) and in the upper category of **income** (OR=1.69, 95% CI 1.59- 1.80) and **physical activity** (OR=1.16, 95% CI 1.11-1.22).

In the latter period of inclusion **(1996- 2003)**, females were **less likely to be former smokers** if in the **upper category** of **education** (OR=0.37, 95% CI 0.35-0.39), and **physical activity** (OR=0.95, 95% CI 0.90-1.00). In contrast, females were **more likely to be former smokers** when were M**arried/cohabiting** (OR=1.48, 95% CI 1.41-1.54), **divorced/widowed** (OR= 2.21, 95% CI 1.73-2.83) and, in the upper category of **income** (OR=1.24, 95% CI 1.15-1.35) and **BMI** (OR=1.35, 95% CI 1.28-1.42).

Table 10. Multivariable [a, b] Odd ratios (ORs) with 95% confidence intervals (Ci's) for Current Smokers compared with Never smokers according to selected Socio- economic and Lifestyle characteristics by calendar time period for study enrolment among Norwegian females (1974- 2003).

Inclusion Date		**1974- 1980** (n = 24832) ***9.8%***			**1981- 1987** (n = 14080) ***5.6%***			**1988-1995** (n = 106046) ***45.8%***			**1996-2003** (n = 90868) ***38.9%***			**All 1974- 2003** (n = 235,826)		
Covariates		**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**	**Number of Current Smokers**	**OR**	**95% CI**
Education	Low	6004	1	N.A.	2517	1	N.A	17704	1	N.A	10191	1	N.A.	36416	1	N.A.
	Moderate	4583	0.60	0.56- 0.63	3591	0.48	0.44- 0.52	30338	0.47	0.45- 0.48	26610	0.53	0.51- 0.55	65122	0.56	0.55- 0.58
	High	631	0.25	0.22- 0.28	580	0.17	0.15- 0.19	5686	0.14	0.13- 0.14	5275	0.14	0.13- 0.15	12172	0.17	0.16- 0.17
Income	Low	2512	1	N.A.	1218	1	N.A.	9623	1	N.A.	8607	1	N.A.	21960	1	N.A.
	Moderate	7874	1.31	1.23- 1.39	4942	1.19	1.09- 1.31	39370	1.29	1.25- 1.33	30465	1.43	1.38- 1.49	82651	1.41	1.38- 1.44
	High	832	1.82	1.61- 2.06	528	1.27	1.09- 1.48	4735	1.45	1.37- 1.53	3004	1.63	1.53- 1.73	9099	1.60	1.54- 1.66
Marital Status	Married/ cohabiting	9486	1	N.A.	5204	1	N.A.	39668	1	N.A.	24916	1	N.A.	79274	1	N.A.
	Single	1000	0.79	0.72- 0.88	632	0.85	0.74- 0.99	3951	1.14	1.08- 1.20	7947	1.51	1.45- 1.57	13530	1.27	1.23- 1.31
	Divorced/ Widowed	732	2.26	1.99- 2.56	852	2.63	2.30- 3.00	10109	2.28	2.19- 2.37	9213	2.07	1.99- 2.16	20906	2.25	2.20- 2.31

BMI	<25Kg/m²	8030	1	N.A.	4953	1	N.A.	37992	1	N.A.	26157	1	N.A.	77132	1	N.A.
	25-30Kg/m²	2412	0.62	0.59- 0.66	1318	0.64	0.59- 0.70	12099	0.69	0.66- 0.71	11725	0.74	0.71- 0.76	27554	0.70	0.69- 0.71
	+30Kg/m²	776	0.50	0.45- 0.55	417	0.53	0.46- 0.61	3637	0.52	0.49- 0.54	4194	0.55	0.52- 0.57	9024	0.53	0.52- 0.55
Physical Activity	Sedentary	2751	1	N.A.	1589	1	N.A.	12314	1	N.A.	8133	1	N.A.	24787	1	N.A.
	Moderate	8439	0.81	0.76- 0.86	5073	0.60	0.55- 0.65	40752	0.66	0.63- 0.68	25647	0.80	0.77- 0.83	79911	0.72	0.70- 0.74
	Heavy	28	0.70	0.40- 1.21	26	0.21	0.13- 0.33	662	0.52	0.46- 0.58	8296	0.66	0.63- 0.69	9012	0.64	0.61- 0.66

a. Adjusted for age at inclusion at enrolment.
b. All variables are adjusted for each other (education, income, marital status, BMI and physical activity).

Table 11. Multivariable [a, b] Odd ratios (ORs) with 95% confidence intervals (Ci's) for Former Smokers compared with Never smokers according to selected Socio- economic and Lifestyle characteristics by calendar time period for study enrolment among Norwegian females (1974- 2003).

Inclusion Date		**1974- 1980** (n = 17350) ***8.8%***			**1981- 1987** (n = 10418) ***5.2%***			**1988-1995** (n = 79789) ***43.7%***			**1996-2003** (n = 77692) ***42.3%***			**All 1974- 2003** (n = 185,249)		
Covariates		**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**	**Number of Former Smokers**	**OR**	**95% CI**
Education	Low	1608	1	N.A.	825	1	N.A	5881	1	N.A	4632	1	N.A.	12946	1	N.A.
	Moderate	1671	0.87	0.80- 0.94	1666	0.71	0.64- 0.79	15561	0.78	0.75- 0.82	17302	0.83	0.80- 0.87	36200	0.94	0.92- 0.97
	High	457	0.82	0.71- 0.93	535	0.51	0.44- 0.58	6029	0.50	0.48- 0.53	6966	0.47	0.44- 0.49	13987	0.60	0.58- 0.62

Income	Low	777	1	N.A.	458	1	N.A.	4388	1	N.A.	5061	1	N.A.	10684	1	N.A.
	Moderate	2602	1.29	1.18- 1.42	2231	1.29	1.15- 1.46	19797	1.30	1.25- 1.36	20905	1.40	1.35- 1.46	45535	1.39	1.35- 1.43
	High	357	1.59	1.35- 1.87	337	1.48	1.24- 1.78	3286	1.49	1.40- 1.59	2934	1.69	1.59- 1.80	6914	1.58	1.52- 1.65
Marital Status	Married/ cohabiting	3359	1	N.A.	2577	1	N.A.	22718	1	N.A.	20473	1	N.A.	49127	1	N.A.
	Single	236	0.56	0.48- 0.66	215	0.59	0.49- 0.71	1550	0.75	0.70- 0.80	4103	0.95	0.91- 1.03	6104	0.88	0.85- 0.91
	Divorced/ Widowed	141	1.24	1.02- 1.51	234	1.14	1.22- 1.72	3203	1.24	1.18- 1.30	4324	1.17	1.12- 1.22	7902	1.30	1.26- 1.34
BMI	> 25Kg/m^2	2444	1	N.A.	1996	1	N.A.	17294	1	N.A.	15470	1	N.A.	37204	1	N.A.
	25-30Kg/m^2	981	0.89	0.81- 0.96	773	1.02	0.92- 1.12	7712	1.02	0.99- 1.06	9625	1.05	1.02- 1.09	19091	1.04	1.02- 1.07
	+30Kg/m^2	311	0.74	0.65- 0.85	257	0.94	0.80- 1.10	2465	0.92	0.87- 0.97	3805	0.94	0.90- 0.99	6838	0.96	0.93- 0.99
Physical Activity	Sedentary	719	1	N.A.	523	1	N.A.	4485	1	N.A.	4077	1	N.A.	9804	1	N.A.
	Moderate	3003	1.07	0.97- 1.17	2474	0.89	0.79- 1.00	22393	0.98	0.94- 1.02	17408	1.05	1.00- 1.09	45278	1.01	0.98- 1.04
	Heavy	14	1.59	0.82- 3.07	29	0.86	0.55- 1.35	593	1.30	1.16- 1.45	7415	1.16	1.11- 1.22	8051	1.35	1.30- 1.40

a. Adjusted for age at inclusion at enrolment.
b. All variables are adjusted for each other (education, income, marital status, BMI and physical activity).

5. Discussion

5.1 Main Findings

5.1.1 Smoking Prevalence Changes

From the initial studied period of (1974- 1980) to the last studied period (1996- 2003), the **prevalence of current smokers** decreased by **20.5%** points (53.9% to 33.4%) for the **males**, and for the **females** the decrease was **3.3%** points (38% to 34.7%).

5.1.2 Changes in Smoking Status According to SES, Marital Status and Lifestyle

In the final studied period (1996- 2003) there was an **increase** in the male and female proportion of **current smokers** in the following categories when compared to their current smoking counterparts in the first period (1974- 1980):

- High and moderate levels of education. - High income level. - Divorced/ widowed.

- High BMI level (+30Kg/m^2). - Hard physical activity level.

5.1.3 Smoking status association with SES, marital status and lifestyle

Males in the initial period (1974- 1980), were **less likely** to be **current smokers** if in the **single** category, and were in the upper categories of **education, income, BMI** and **physical activity**, while, **divorced/widowed** males were **more likely** to be **current smokers**.

In the final period (1996- 2003), **males** were still **less likely** to be **current smokers** if they were in the upper categories of **education, BMI** and **physical activity.** And they were still more likely to current smokers in the **divorced/widowed** category, and in the upper categories of **income**. However, in this final period males were now more likely to be current smokers if they were in the **single** category (table 6).

Females, in the initial period (1974- 1980), were **less likely** to be **current smokers** if **single**, and were in the upper categories of **education, BMI** and **physical activity,** while females that

were **divorced/widowed** and, in the upper categories of i**ncome**, were **more likely** to be **current smokers**.

In the final period (1996- 2003), **females** were still **less likely** to be **current smokers** if they were in the upper categories of **education, BMI** and **physical activity.** Females in the D**ivorced/widowed** category, and in the upper categories of **income** were also still more likely to be current smoker. However, in this final period females were now more likely to be current smokers if they were in the **single** category (Table 10).

5.2 This study's findings in relation to other studies

5.2.1 Smoking prevalence changes from 1974 to 2003

Our studied population showed a **continuous decrease in the prevalence of current smokers.** This decrease was greater for males than females, resulting in just a 1.3% difference in smoking prevalence between genders by the last studied period (1996- 2003). These changes in the smoking prevalence of the male and female population, coincide with the prevalence changes established by Lopez et al., (1994) in the stages of the smoking epidemic model (2). Furthermore, these results match similar Norwegian studies conducted by Gram et al., (2015), Lund (2014) and Rönneberg et al., (1994) that found a decrease in the **prevalence of smokers**, with a higher reduction for the males when compared to their female counterparts in the last decades, resulting in a $\pm$30% smoking prevalence of for both sexes by the 1996-2003 period.

The significant decrease in the smoking prevalence found in this study, emerges as a result of strong public health interventions based on taxation, restrictions of smoking in common areas, and massive prevention campaigns that have increased the knowledge and awareness of the negative effects of smoking on health, and changed the social perception of the smoking habit. These different measures have shown their effectiveness in smoking prevention and cessation

in Norway during the last decades reducing the smoking prevalence to 13%, for both males and females by 2015 (25, 50).

5.2.2 Smoking status associations with SES, marital status and lifestyle

Education

Higher education levels provide important skills that allow a deeper understanding of the negative health effects of smoking, reduce the chances of ever starting to smoke, and increases the likelihood of achieving a successful smoking cessation. Education level was one of the strongest socio- demographic predictors for smoking in this cross- sectional study, and it revealed educational differences between smokers and non-smokers: **Males and females with a higher education level were less likely to be smokers**; An association that is in agreement with previous findings made by Cavelaars et al., (2000); Vedøy, (2014); Wetter et al., (2005) and 2015 Norwegian SSB data (51).

Interestingly, across studied periods, there was a continuous increase in the proportion of participants (current, former and never smokers) in the higher categories of education. These changes in the educational characteristics of our studied population, can be linked to important developments that the Norwegian educational system underwent, in which, all Norwegians gained equal access to higher education standards (52). These developments re- shaped our studied population into having more total years of education by the final studied period in 1996-2003 when compared with their counterparts in 1974- 1980.

Income

An unexpected finding in this study was the association between Income and smoking: **Males and females with a higher income level were more likely to be smokers**. These findings are unexpected due to the fact that most studies associate high income levels with lower likelihood

of smoking (2;4), an association that was only present for the males in the first studied period (Table 6).

A possible explanation for these unconventional results may be found in the changes experienced in the Norwegian economy from 1950 and the decades that followed. During this periods, Norway showed a continuous annual growth rate of the national GDP, stable inflation rates, an increase in the foreign trade, minimal unemployment and steady increases in wages (55). This economic development emerged as a result of good economic planning and a considerable public sector that gave Norwegians access to greater living standards, social security and evenly-distributed wealth (56).

As the majority of the Norwegian population has access to higher income levels, their personal choices such as smoking (an expensive habit due to heavy taxes) do not have direct consequences for the household income and the individual's economy. Additionally, the welfare system will largely cover the expenses related to poor health and disability due to smoking. These characteristics of the Norwegian economical infrastructure, give as a result, the unexpected findings in this study, were a higher socio- economic status in the form of a higher income level increases the likelihood of smoking for both males and females (Table 6 and 10).

Marital status

The studied population showed a strong association between marital status and smoking: **Divorced/widowed male and female participants were more likely to be smokers**. Additionally, the proportion of current smokers that were divorced/widowed in 1974- 1980 had significantly increased for both sexes when we come to the last studied period of 1996 -2003 (Fig 7, Fig 13).

As for single male and female participants, they were less likely to smoke during the first two studied periods (1974- 1987). This association changed in the last two studied periods (1988-2003) into a higher likelihood of smoking, if single.

These findings match those in previous Scandinavian studies carried out by Lindström, (2010) and Nystedt, (2006) that, attribute an enormous value to the social support of a partner; As the spouse/partner is the most significant person in the social network of an individual, being married or cohabiting increases the informational, material and emotional support thus, giving marital status a significant correlation with never smoking, and smoking cessation.

Body mass index

BMI showed a linear relationship with smoking: **Males and females in the upper categories of BMI were less likely to be smokers**. These findings are consistent with previous studies carried out by Chiolero, (2007a), (2008b); Kvaavik et al,. (2004) and Pearson et al., (2012), that found lower BMI values for current smokers due to increase in energy expenditure, reduction of appetite caused by nicotine, as well as, preclinical concomitant diseases that cause emaciation such as cancer.

Interestingly, when examining the changes in BMI characteristics, the proportion of females and males (current, never and former smokers) with higher levels of BMI increased significantly in 1996- 2003, when compared to their counterparts in 1974- 1980. This increase of proportions in the upper levels of BMI, can be explained by socio- cultural changes in Norway during the last decades, in which, a richer diversity of food, an excessive energy intake, less physically demanding jobs and the use of technologies that diminish physical activity have resulted in a continuous increase of the Body Mass Index values for the entire Norwegian population, and consequently, our studied population as well (58, 59).

Physical activity

Physical activity was associated with smoking status. **Males and females that practiced heavy or moderate physical activity were less likely to be smokers**. These results are similar to previous Norwegian and US findings stablishing that, smokers practice less physical activity per week, exercise for shorter periods, and are in general less active than non-smokers (7, 60).

Surprisingly, the proportion of male and female smokers that practiced heavy physical activity in the last studied period of 1996- 2003, showed a dramatic increase when compared to their counterparts in the first studied period in 1974- 1980.

An explanation for these surprising findings, can be linked to pro- health and wellbeing initiatives supported by the social and economic development of Norway. As larger governmental budgets are used to build up more leisure facilities and recreational areas, the sport market in Norway has gained a wider selection of equipment and greater access to old and new sports. Emphasizes has shifted from group physical activity to hard individualized trainings, like calorie burning and /or muscle building, focused on the enhancement of body appearance (61). This important change in the way physical activity is practiced in Norway, can explain the dramatic increase of the proportion of current smoker males and females practicing heavy physical activity in the final period of this study (Figure 9, Figure 15).

5.3 Methodological Considerations

5.3.1 External validity

Our study sample is a large one, and it's formed by participants from all over Norway. The data sets of all of the included surveys have been extensively validated (39, 40). Even though, it is complex to generalize the results from a study to a wider population, due to the size and

characteristics of our sample we conclude that, the results obtained in this study may be generalized to the Norwegian population.

5.3.2 Internal Validity

In our study the large sample reduces the chances of sampling error and increases the precision of the results obtained. We also tested our hypotheses at the 95% CI to avoid random error.

As for systematic error, for this cross sectional study, all participants were selected based on gender and age. We also had a similar proportion of males and females that represented both urban and rural Norway. In this study there was no chance to control for the differences between participants and non- participants; but we assume non- participants aren't misrepresented by those who did participate in the surveys. The overall rates of participation ranged from 88% in the Norwegian counties study to 56% in the CONOR (40).

Other concern was recall bias, a common issue in studies of smoking exposure. But, due to self-reporting of smoking information in the baseline questionnaires, bias in the determination of smoking status was avoided. The use of current, former and never smoker's categories in our analyses made it possible to establish a good differentiation between smoking status outcomes and changes, as well as, more accurate results regarding the association between SES, marital status, and physical activity with Smoking status. Furthermore, the smoking prevalence found in this study was similar to the prevalence found in the general Norwegian population during the same studied periods (25).

For all the surveys in this study, age was one of the main criteria for the enrolment of participants, who were mostly 40 to 45 years. In order to control the magnitude of confounding by age, the univariate analyses (stratified by gender, date of inclusion and smoking status) were adjusted for age at inclusion. As for the multivariate analysis, the final analysis model included

age at inclusion, SES, marital status and lifestyle variables together, adjusting for these possible confounders in this analysis.

5.3.3 Strengths

The main strength of this study was its large sample size, obtained from high participation rates in all of the included surveys. Our sample represents successfully males and females in rural and urban Norway. The information from participants was obtained at study enrollment (Height and weight were measured, rather than self-reported) and from the SSB, a recognized Norwegian national registry, reducing the possibility of recall bias and measurement bias. As some findings can be influenced by socio- cultural trends during the studied periods, the possibility of analyzing these trends with the existing comparable data obtained for the same periods, reflects with accuracy, and gives a more precise context to the smoking trends in our studied population.

5.3.4 Limitations

Cross sectional studies offer information from the studied population at a specific point in time, there for, our findings must be interpreted based on this limitation. Self- reporting data is prone to recall bias, overestimating the amount of physical activity is a potential source of bias that is difficult to adjust for. Alcohol could have been a potential confounder in this study, because information on alcohol consumption was missing for almost 60% of the participants, therefor it was decided not to use this variable in the main analyses.

5.3.5 Contributions to existing knowledge

As Norway is known for its high quality health registry systems (62), the analysis of such a large and representative sample of population, will provide extended knowledge on the association between smoking and SES, marital status, BMI and Physical activity, as well as

giving a more precise account of socio- cultural and economic contexts in which these associations occurred in Norway.

This obtained knowledge will also provide a background for better suited prevention and intervention initiatives against smoking, and a more targeted dissemination of information on smoking related health consequences. These are important public health initiatives that will alleviate the enormous social burden of cigarette smoking in Norway and consequently, preserve state resources by reducing specialized health care needs, and most importantly, they will save lives.

6. Conclusions

- From the initial studied period (1974- 1980) to the final (1996- 2003), the prevalence of male and female current smokers decreased significantly.

- From the initial studied period (1974- 1980) to the final (1996- 2003) there was an increase in the proportion of males and females current smokers in the following categories:
  - Higher level of education.
  - Divorced/ widowed category.
  - Higher levels of Physical activity.
  - Higher income levels.
  - BMI levels (+30kg/m^2).

- In both, first (1974- 1980) and last studied period (1996- 2003) smoking was associated with SES and marital status. Lower levels of education and being divorced/widowed increased the likelihood of smoking for males and females in this study. In the same periods, lifestyle choices were also associated with smoking. Males and females in the upper levels of BMI and physical activity were less likely to smoke.

  As for income levels and single marital status, these predictors showed contrasting associations with male and female current smokers in the first and last studied period.

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APPENDIX A

1. Smoking Status

Information regarding the smoking exposure was collected based questions aimed to define if participants were pipe or cigarette smokers, their current and former smoking habits. Former smokers were asked about time since quitting. Participants who were neither current nor former smokers were classified as never smokers.

Current and Former smokers

In the Norwegian counties study I, II and III, this was based on the question "Do you smoke daily now?" A positive answer will give a categorization of daily smoker. In the 40 years study I and CONOR, it was based on the question "Do you smoke daily now?", in the 40 years study II- IV it was based on the questions "Do you smoke cigarettes daily? Or "Do you smoke cigar daily?" "Do you smoke pipe daily?", If participants have answered "Yes" on any of the above questions, then they were categorized as current smokers. The daily-smokers variable in CONOR was based on the question "Do you smoke daily?" (In CONOR, this question includes cigarettes, pipe and cigar daily smokers, according to CONOR documentation (variable a8_0)).

After categorizing all current smokers the remaining participants in the former smoker's category were categorized as follows: In the Norwegian counties study and the 40 years cohort I and II those participants answering "Yes" to the questions "Have you smoked cigarettes daily previously", or answering any value (except zero) to the question "How long since you quit smoking?", and "How many years have you smoked daily?" and "how many cigarettes do you or did you smoke daily?", and not current smoker, then categorized as a former smokers. In the 40 years cohort III and IV any answer more than zero in the question "if you have smoked previously, how long since you quit?" then a former smoker. (As answering option is in years, we might misclassify those answering zero because they have quit less than 1 year ago.) Also, answering any value more than zero to the questions "how many cigarettes do you smoke or did you smoke daily", "how old were you when you started to smoke daily?" or "how many years have you smoked daily?" then classified as former smokers, if not already classified as a current smoker. In CONOR if participants have valid answer (greater than 0) in questions "How long time since quit smoking (a_9)?" or numbers of cigarettes smoking daily (a_10) or "How old were you when you start smoking (a_11)? or "How many years of smoking in total(a_12_1).?" then categorized as former smokers.

2. Covariates

Education

The level of education was established with information from the SSB and the censuses done in 1970, 1980 and 1990. It was calculated based on the number of completed years of education and by consensus the highest level of education from the 1980 or 1990 censuses were used. If there was missing information, the 1970 census information was used; if no information from in any census then declared real missing. This variable was already categorized when received in four levels of education **1.** Low; **2.** Low/Medium; **3.** Medium/high; **4.** High (38, 39).

Income

The income variable was already categorized when received. The level of income was established with information from the SSB and the censuses done in 1970, 1980 and 1990. Because the income information was categorized differently in the different censuses (1970, 1980, 1990) the distribution of all incomes in each census was categorized into quartiles to be able to compare the information obtained. The **highest quartile** registered at either census counted for that individual (master file called Income_max_quart) (38, 39).

Marital status

The information regarding this variable was obtained from the health surveys and information from the SSB, this variable was already categorized when received. **1**. Not married; **2**.Married; **3.** Widowed; **4.** Divorced; **5.**Separated; **6.**Registered partner; **7.**Separated partner; **8.** Divorced partner; **9.** Surviving partner.

Body Mass Index

This variable was already categorized when received. All of the participants had their height and weight recorded at the screening facilities. BMI was calculated by the WHO standard formula (49). The observations with extreme values for height (<100 or >250 cm), weight (<35 or >250Kg) and BMI (<15 or >60Kg/m^2) were set to missing. 1 to 3 Categories of BMI were established **1.** <18.5- 24.9 Kg/m^2; **2.**25- 29.9 Kg/m^2; **3.** >30 Kg/m^2 (38, 39).

Physical Activity

This variable was already categorized when received. The information regarding (PA) was acquired by a self- reported measure during the health surveys and, it was classified into 1 to 4 categorical values of physical activity performed: **1**: Light; **2**: Mild; **3**: Moderate; **4**: Hard. (38, 39).